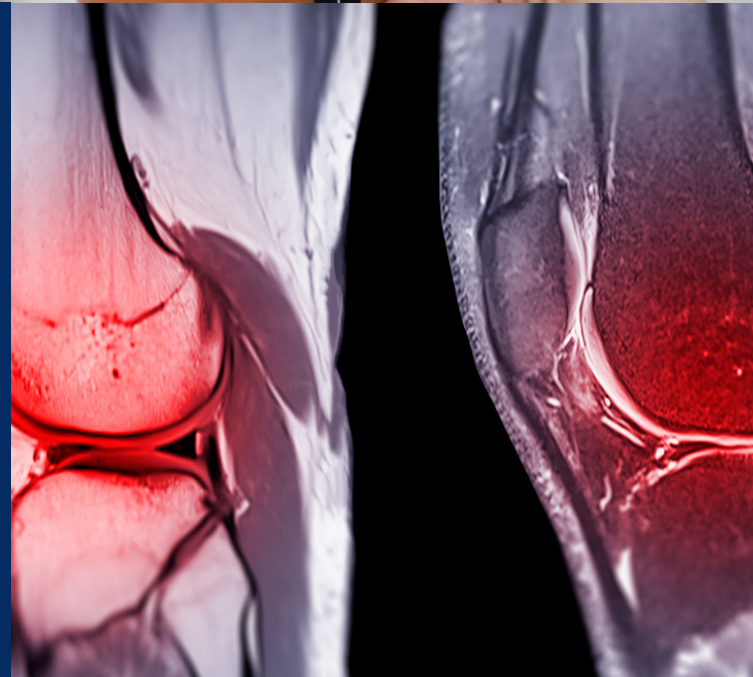




DUKE SPORTS MEDICINE



**3rd ANNUAL
WILLIAM E. GARRETT, Jr, MD, PhD
SPORTS MEDICINE
RESEARCH DAY**

JUNE 22, 2022

Dr. William E. Garrett, Jr, MD, PhD



April 23, 1949–May 4, 2019

Dr. Garrett was a consummate physician, clinician–scientist, and teacher during his 40+ years of service to Duke University Medical Center and his patients. As a specialist in sports medicine for thirty years, he served as the Medical Director of the U.S. Soccer Federation and Team Physician for the U.S. Men and Women's National Soccer teams, as well as many Duke teams. As a teacher, he has the unique distinction of earning the Outstanding Teacher Award by both the residents at the Duke and UNC Departments of Orthopaedics. He was awarded the Duke Department of Orthopaedic Surgery Master Orthopaedist Award. Posthumously, Dr. Garrett was inducted into the AOSSM Hall of Fame. Dr. Garrett's research awards include the Kappa Delta Award (ORS), Citation Award (ACSM), the Award of Merit (AOSSM), Excellence in Research in the Category of Basic Science (AOSSM), the Excellence in Research Award (AOSSM), the O'Donoghue Award (AOSSM). It is his friendship, mentorship, and love of research and Sports Medicine we honor at this event.

Dr. William E. Garrett, Jr. Visiting Professors

BRADEN C. FLEMING, PHD

Braden Fleming, PhD's multi-award winning work focuses on knee ligament injuries, soft tissue biomechanics, and biomedical instrumentation.

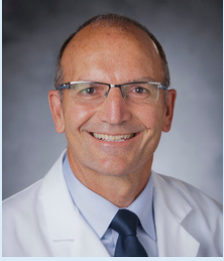


MARTHA MURRAY, MD

Dr. Murray has developed a novel technique of ACL repair that uses a bio-engineered scaffold to stimulate healing of the ligament instead. Having taken this BridgeEnhanced ACL Restoration from the bench to the bedside, this scaffold has been granted FDA DeNovo Approval.



PRESENTATIONS



Opening Remarks

Annunziato (Ned) Amendola, MD, Professor of Orthopaedic Surgery; Chief, Division of Sports Medicine; Director, Urbaniak Sports Sciences institute



Keynote

Martha Murray, MD and Braden C. Fleming, PhD

“Bridge Enhanced ACL Restoration (BEAR) – Clinical trial Updates and Quantitative MRI as a predictor of ACL Surgery Outcomes”



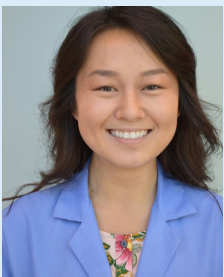
Olivia Abdoo, PT, DPT, CSCS

“Do climate and environmental characteristics influence sports-related concussion incidence in outdoor contact sports? A systematic review”



Nimit Lad, MD

“A Retrospective Review of Patient Reported Outcomes in Glenohumeral Arthritis”



Luting Eckensweiler, DO

“Post-procedure rehabilitation protocols in patients with patellar or Achilles tendinopathy treated with platelet-rich plasma (PRP): a scoping review”

PRESENTATIONS



Jeremiah Johnson, MD

"Retrospective Review of Simultaneous versus Staged Hip Arthroscopy for the Treatment of Femoroacetabular Impingement"



Laura Pietrosimone PT, DPT, PhD

"Optimizing Biomechanical Loading & Physical Activity following Lower Extremity Musculoskeletal Injury"



C. Ellis Wisely, MD, MBA

"Oculomotor Testing for Diagnosis and Monitoring of Traumatic Brain Injury"



Samantha Tayne, MD

"The effect of posterior tibial slope on ACL strain during landing from a single leg jump: An in vivo MRI-based study"



Kathryn Dasburg, MD

"A Comparison of Platelet Rich Plasma (PRP) Systems"



Amy McNulty, PhD

"Uncovering Biomechanical and Biological Changes Following Meniscus Injury to Improve Joint Health"

PRESENTATIONS



Steven Bokshan, MD

"Risk Factors for Rotator Cuff Fatty Accumulation: A Histological Analysis"



Skyler Gick, DO

"Association Between Achilles Tendinopathy and Metabolic Disease: A Systematic Review"



Tommy Otley, PT, DPT, CSCS

"Relationships between subjective player readiness, field performance metrics, and game-day countermovement jump performance in collegiate male soccer players"



Lou DeFrate, ScD

"The Application of Imaging Techniques to the Study of In Vivo Knee Function"

ABSTRACTS

ABSTRACTS

Do climate and environmental characteristics influence sports-related concussion incidence in outdoor contact sports? A systematic review.

Abdo O; Martinez C; Forshey T; Myers H; Hendren S; Pietrosimone L

Purpose

1.6-3.8 million sports related concussions are reported annually in the United States. Previous research has investigated the relationship between various climate and environmental factors that may contribute to these incidence rates such as temperature, altitude, and field type. Environmental and climate variables may provide unique insight into clinical decision making for medical personnel when providing coverage for outdoor contact sports. However, there is no current systematic review critically appraising the literature to determine if a significant relationship exists. Therefore, the purpose of this systematic review is to obtain a comprehensive understanding of the implications that environmental factors may have on sports related concussion incidence in outdoor contact sports.

Materials/Methods

A comprehensive search was conducted by a professional medical librarian within MEDLINE (via OVID), EMBASE (via Elsevier), CINAHL Complete (via EBSCOhost), SPORTDiscus (via EBSCOhost) Scopus (via Elsevier) from inception to December 22, 2021. Studies were required to meet the following inclusion criteria: report on incidence, prevalence, or rate of sport-related concussion, assess data of athletes of outdoor contact sports, report on one or more climate/environmental factors, and diagnosis of concussion performed by a licensed medical professional (MD, DO, PT, ATC). Reasons for exclusion included no report on extrinsic or environmental factors, wrong study design (case report, conference abstract, clinical commentary), no data on concussion incidence, and self-reporting of concussion diagnosis. Systematic Review was conducted utilizing Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines employing two reviewers at each phase of the process (title/abstract review, full text review, and data extraction) and a third reviewer for conflict resolution. The risk of bias for all articles selected for inclusion was performed independently by two reviewers utilizing a modified version of a tool created and validated by Hoy et al. 2012 for prevalence studies. The level of agreeability of the risk of bias between the two reviewers was calculated using Cohen's Kappa.

Results

7558 articles were initially reviewed and 20 met the inclusion criteria. The level of agreeability of the risk of bias between the two reviewers was 0.89 with 55% (11/20) of articles having low risk of bias and 45% (9/20) having moderate risk of bias. Football followed by rugby, soccer, and lacrosse were the most common sports investigated by authors (14, 3, 3, and 2 studies, respectively). There was moderate to strong strength of evidence concluding no difference between surface type (grass versus artificial) on concussion risk. Of two studies investigating turf specific qualities, one found lower rates of concussion when playing on light weight systems, while the other found no difference in concussion rate between pad and no-pad turf fields. Moderate to strong strength of evidence was found supporting no difference in concussion incidence based on the location of game (home versus away). There was no consensus on the effects of altitude or temperature on concussion incidence. One high quality study found a decreased risk of concussion when playing in wet conditions versus dry conditions. Heterogenous populations and data collection methods prevented extraction and analysis of data via meta-analysis.

Conclusion and Clinical Relevance

The results of this systematic review found minimal consensus on specific environmental factors that influence concussion incidence in outdoor contact sports. However, many studies were of high quality and give insight into further opportunity for investigation into this question. Future research should utilize large injury surveillance databases but have participating teams include information on various environmental factors that can easily be identified and tracked to enable for an increased sample size, statistical analysis, and generalizability of results.

ABSTRACTS

A Retrospective Review of Patient Reported Outcomes in Glenohumeral Arthritis

Lad N, Christian R, Reinke EK, Lau B, Lassiter T

Introduction

Glenohumeral osteoarthritis (GHOA) is a common condition that can have a debilitating effect on patients. Multiple non-operative and operative treatment options exist to address patient symptoms. In addition to osteoarthritis pattern and severity, patient reported outcome (PRO) measures can serve as a valuable tool to assist in decision making for an optimal treatment. The purpose of this study was to identify trends in PROs in patients with glenohumeral osteoarthritis who were treated with glenohumeral corticosteroid injections, anatomic total shoulder arthroplasty, or reverse total shoulder arthroplasty.

Methods

A retrospective review of 100 patients with glenohumeral osteoarthritis from a single surgeon's shoulder practice was conducted. 37 patients were treated with a glenohumeral corticosteroid injection, 19 patients with anatomic total shoulder arthroplasty (TSA), and 44 with reverse total shoulder arthroplasty. Pre-treatment PROs were reported including Visual Analog Scale (VAS, range 0–10), American Shoulder and Elbow Surgeon score (ASES), Single Assessment Numeric Evaluation (SANE), Patient-Reported Outcome Measurement Information System (PROMIS) physical function (PF), PROMIS Depression, and PROMIS pain interference (PI). Mann-Whitney and Kruskal-Wallis statistical methods were utilized for analysis.

Results

100 patients total completed the PROMIS questionnaires. Mean PROMIS PF scores were 38 \pm 6.4 for reverse total shoulder arthroplasty, 40 \pm 7.2 for anatomic total shoulder arthroplasty, and 37 \pm 7.0 for glenohumeral corticosteroid injections ($p=0.6$), which were not statistically different. Mean PROMIS PI scores were also not statistically different with values of 63 \pm 4.9, 63 \pm 7.2, and 63 \pm 5.6 for each of the treatments ($p=0.9$). The mean PROMIS depression scores of 47 \pm 8.8, 51 \pm 8.3, and 52 \pm 9.6 also did not show statistical difference ($p=0.06$). The glenohumeral injection group did show a wider range of values and 25% of patients reported a 60 or higher on the PROMIS depression score. Mean VAS pain scores were 6 \pm 2.5 for reverse TSA, 6 \pm 2.7 for anatomic TSA, and 6 \pm 1.7 for glenohumeral shoulder injections and were not statistically different ($p=0.9$). SANE scores were not statistically different with 36 \pm 18 for reverse TSA, and 30 \pm 17.4 for anatomic TSA ($p=0.6$). ASES scores for reverse TSA were 35 \pm 13.4 and 34 \pm 18 for anatomic TSA ($p=0.8$) were not statistically different.

Discussion

Comparing PROMIS (PF, depression, and PI), VAS pain, SANE, and ASES scores for patients with glenohumeral osteoarthritis treated with glenohumeral injections, anatomic TSA, or reverse TSA did not result in statistically different scores between the different treatment groups. In this particular population, patient perceptions of pain and limitations in function did not correlate with nonoperative versus operative treatment options. Of note, patients in the glenohumeral injection group had a higher number of patients score above 60 on the PROMIS Depression scale, but was not found to be statistically significant. Limitations in this study include that a limited number of patients treated by a single surgeon were reviewed. Within each treatment, confounding variables for any given treatment chosen could not be discerned and could be a source of bias. Further investigation with a larger cohort and additional patient variables may help identify trends in selecting optimal treatment options for patients with glenohumeral osteoarthritis.

Post-procedure rehabilitation protocols in patients with patellar or Achilles tendinopathy treated with platelet-rich plasma (PRP): a scoping review

Eckensweiler, L; Pietrosimone, L; Gick, S; Hendren, S; Ceraulo, A

Objective

Lower extremity tendinopathy is a common clinical syndrome among elite and recreational athletes. Platelet-rich plasma (PRP) has been emerging as a non-operative treatment option for tendinopathy, followed by rehabilitation. Currently, to our knowledge, there are no standardized guidelines of post-PRP rehabilitation protocols. The purpose of this review is to observe current protocols being followed in post-PRP rehabilitation, specifically for lower extremity load-bearing (patellar and Achilles) tendons.

Literature review

An electronic, comprehensive search was conducted using MEDLINE, Embase, CINAHL, SPORTDiscus, and Scopus on rehabilitation protocols for patellar or Achilles tendinopathy treated with PRP.

Methods

Our inclusion criteria were: (1) articles on patellar or Achilles tendinopathy who received PRP, (2) a description of the post-PRP rehabilitation protocol, and (3) articles published in English. Our exclusion criteria were: (1) articles that did not remark on post-PRP protocol, (2) articles on PRP treatment for full tendon rupture, and (3) articles on use of other injection preparations with PRP.

Data collection and results

Seven studies met inclusion criteria: four studies focused on Achilles tendinopathy, two studies focused on patellar tendinopathy, and one study encompassed general tendinopathy with a lower extremity rehabilitation protocol described. All studies described treatment with a one-time PRP injection except for one randomized controlled trial on Achilles tendinopathy which described rehabilitation with a four-part PRP treatment course. Rehabilitation protocol descriptions ranged in length from 2 weeks to 14 weeks with a median of 12 weeks. Two articles (29%) included post-procedure non-weightbearing status. Six articles (86%) included a post-procedure rest period, ranging from 2 days to 2 weeks. Four articles (57%) included timing of introduction of stretching after PRP procedure, ranging from 4 days post-procedure to 2 weeks. Two articles (29%) included use of a brace or boot. All included introduction of eccentric loading.

Conclusion

PRP use for treatment of tendinopathy has gained momentum in recent years, prompting our exploration of post-PRP rehabilitation protocols published in the Literature. While it has been deemed likely that adhering to site-specific post-PRP rehabilitation protocols may improve outcomes, this has largely been based on expert opinion to date. Our review demonstrates that published post-PRP protocols have significant heterogeneity, with variation of factors including length of rehabilitation program, weightbearing status, and initial rest period, among others. Though there is evidence supporting tendon healing via mechanical loading, there lacks uniform rehabilitation guidelines for tendinopathy after PRP treatment. Based on this review, next steps may include proposing expert consensus on standardized rehabilitation protocols for use as a referential starting point for clinicians.

ABSTRACTS

Retrospective Review of Simultaneous Versus Staged Hip Arthroscopy for the Treatment of Femoroacetabular Impingement

Johnson, J; Chinedu, O; Poehlein, E; Green C; Reinke EK; Mather, RC

It is common for patients undergoing hip arthroscopy for femoroacetabular impingement (FAI) to have bilateral pathology. The purpose of this study was to compare patients undergoing staged versus simultaneous surgery for FAI. A retrospective review of patients undergoing primary bilateral hip arthroscopy for FAI by a single surgeon from January 2015 to December 2021 were evaluated. Demographic, surgical, preoperative and postoperative variables were analyzed. Twenty-five patients with bilateral simultaneous surgery were compared with 183 patients who underwent staged hip surgery. There were no preoperative differences between the two groups. Both groups demonstrated significant improvement in Patient Reported Outcome Measure Information System (PROMIS) functional and pain scores. Patients with FAI undergoing either bilateral simultaneous or staged hip arthroscopy have improved function and pain relief. Further studies are needed to identify patients who would benefit more from staged or simultaneous surgery.

Oculomotor Testing for Diagnosis and Monitoring of Traumatic Brain Injury

Wisely CE, Song I, Gabriel R, Aggarwal S, Mohiuddin O, Whitaker D, Kim T

Objectives

1) To elucidate differences in oculomotor testing performance in patients with and without a history of traumatic brain injury (TBI). 2) To determine how horizontal and vertical saccade performance changes after TBI.

Methods

Retrospective case series of patients with a history of TBI and healthy volunteer control subjects with no TBI history who underwent oculomotor testing with the RightEye Vision System at the Duke Eye Center between 6/30/2017 and 2/28/2021. Bilateral circular smooth pursuits, unilateral horizontal saccades, and unilateral vertical saccades were evaluated for saccade fixation quality and saccade speed. Temporal proximity of testing sessions to most recent TBI episodes was assessed to determine if effects on oculomotor performance changed over time.

Results

115 patients with a history of TBI and 16 control subjects underwent RightEye oculomotor testing. Patients with a TBI history had an average of 1.9 reported concussion events. Median time from most recent TBI to RightEye testing was 169.5 days. Bilateral circular smooth pursuit saccade accuracy ($p=0.002$), horizontal saccade fixation counts for each eye (OD $p=0.02$, OS $p=0.02$), vertical saccade fixation counts for each eye (OD $p=0.001$, OS $p=0.001$), and vertical saccade overshoots in the right eyes, ($p=0.004$) all demonstrated significantly worse performance in patients with a history of TBI when compared to control subjects. Vertical saccade overshoots in left eyes and horizontal saccade overshoots in both eyes demonstrated no significant differences between TBI and control subjects. Smooth pursuit performance was compared in patients evaluated in the first 30 or first 60 days after TBI and versus those evaluated later after their most recent injury. No significant differences were noted in this time from injury analysis.

Conclusion

Performance in circular smooth pursuits, horizontal saccades, and vertical saccades were all compromised in patients with a history of TBI when compared to control subjects with no TBI history. Vertical saccade performance may be affected more than horizontal saccade performance. Further prospective analysis is needed to determine if oculomotor performance demonstrates significant changes over time after a concussion event.

The effect of posterior tibial slope on ACL strain during landing from a single leg jump: An in vivo MRI-based study

Tayne, S; Wittstein, J; Foody, J; Englander, Z; DeFrate, L

Background

Anterior cruciate ligament (ACL) injuries occur at high rates, with a large proportion of injuries occurring via a noncontact mechanism. A number of anatomic factors have been thought to predispose athletes to injury, including the volume and angle of the ACL, as well as bony morphology of tibia and femur such as the tibial slope and geometry of the femoral notch. The main role of the ACL is to resist anterior translation of the tibia relative to the femur, therefore geometry, such as increased posterior tibial slope or a shallow medial tibial plateau, may allow the tibia to slide more anteriorly when the knee is in extension and may contribute to increased ACL strain.

Purpose

The purpose of this study is to evaluate the relationship of medial and lateral posterior tibial slope and ACL strain in healthy subjects in vivo during a single-leg jump.

Study Design

Cohort Study: Level 3 | In vivo MRI based

Methods

A cohort of 25 healthy volunteers underwent MRI of the knee, which were utilized to measure posterior tibial slope in both the medial and lateral compartments. The posterior tibial slope was measured as the angle between an orthogonal to the tibial proximal axis and a line tangent to the plateau cortex, with the proximal tibial axis measured through two perfect circles within the tibial shaft at the notch. The same line tangent to the medial plateau cortex was used to measure medial plateau depth at the deepest part of the concavity. The measurements were taken independently by two orthopaedic surgeons, and intrarater and interrater reliability was calculated. These same patients also underwent evaluation of ACL strain during flight and landing of a single leg jump, using MRI and high-speed biplanar radiography. ACL strain is defined as the length of the ACL during single-leg jump normalized to the length of the ACL in its minimally loaded state during MR imaging.

Results

Our results did not show a significant correlation between medial or lateral tibial slope and peak ACL strain ($\rho = 0.07$, $p = 0.8$ and $\rho = 0.002$, $p = \sim 1.0$, respectively) or ACL strain at initial contact of a single leg jump ($\rho = 0.2$, $p = 0.5$ and $\rho = -0.1$, $p = 0.7$, respectively). There also was no significant correlation between medial tibial plateau depth and ACL strain neither at its peak or at initial contact ($\rho = -0.06$, $p = 0.8$ and $\rho = 0.2$, $p = 0.5$, respectively). Measurements of medial and lateral posterior slope and medial concavity using an MRI technique showed excellent intra-rater reliability (ICC 0.934, 0.970, and 0.955, respectively) and good to excellent inter-rater reliability (ICC 0.770, 0.907, and 0.973, respectively).

Discussion

Our results showed that slope and medial concavity do not appear to be related to ACL strain, which questions current thinking. We demonstrated a reliable technique for measuring the medial and lateral posterior tibial slope and medial tibial plateau depth. Considering previous studies that have shown a risk for ACL tear with increased posterior tibial slope, our results may suggest that posterior tibial slope may only have an effect on ACL strain when above a certain threshold or that increased slope may only convey increased risk of ACL tear when combined with another factor or factors. This study was conducted in healthy subjects with no history of knee injury, therefore future investigation may seek to elucidate a threshold posterior tibial slope and/or medial concavity that correlates with increased ACL strain in injured as compared to healthy patients.

ABSTRACTS

A Comparison of Platelet Rich Plasma (PRP) Systems

Dasburg, K; Emery, O; Rhodes, C; Reinke, E; Stafford, H; Boggess, B; Pyles, C; Ceraulo, A

Purpose of the Study

The primary objective of our study was to compare the composition of Platelet Rich Plasma produced by the 4 different commercially available PRP systems used at Duke Sports Science Institute. Specifically, concentration of Platelets, RBCs, WBCs, and WBC viability were assessed.

Methods/Study Design

This is a descriptive study. Participants were individuals who elected to receive PRP therapy as a treatment modality after evaluation from a provider at DSSI who performs this procedure. Each patient receiving PRP had their waste whole blood and waste PRP evaluated using the Nexcelom Cell counter. All PRP samples were generated with adherence to each system's specific instructions. Data obtained using the Nexcelom Cell Counter was then input into a RedCap Database.

Results

Thus far we have been able to collect the following:

EMCyte Leukocyte Poor with Dr. Stafford – 6 kits

EMCyte Leukocyte Poor with Dr. Ceraulo – 3 kits

Emcyte Leukocyte Rich with Dr. Ceraulo – 2 kits

Arthrex Angel with Dr. Ceraulo – 2 kits

Of the 2 Athrex Angel samples assessed, 50% met criteria for true PRP (increase in platelet concentration 3-5X that of the patient's whole blood)

Of the 9 EmCyte leukocyte Poor samples assessed, 50% met criteria for true PRP (increase in platelet concentration 3-5X that of the patients' whole blood)

Of the 2 EmCyte leukocyte Rich samples assessed, 50% met criteria for true PRP (increase in platelet concentration 3-5X that of the patient's whole blood)

Limitations

The number of patients receiving PRP procedures between the time of IRB approval and data presentation was lower than anticipated. Thus, not enough samples could be collected to determine whether there are statistically significant differences in our cell concentrations between the different PRP systems. More data will need to be collected from each of the systems in the future to be able to complete that portion of this study. The study was initially powered (a-priori) to evaluate differences in these cell concentrations between the different PRP systems, which would require 6 kits be assessed from each of the 4 available systems.

Conclusion/Significance of findings

All kits come with different costs. We can show based on the data we have obtained that the different systems produce PRP with variable cellular compositions. Whether the differences we are seeing are statistically significant is yet to be determined due to limited samples. However, this information probes the question, should we as a department pick one kit and one protocol so that all patients that come to DSSI receive a similar product when having PRP performed. When looking at the data we do have, it is also concerning that, despite which PRP system was used, we thus far only generated true PRP 50% of the time. This also probes the question of if there is any way to better standardize our procedures on how we generate PRP when using each of the different kits. Essentially, should we standardize analyzing the PRP with a cell counter prior to using the PRP in order to ensure that patients are receiving an appropriately concentrated product.

Risk Factors for Rotator Cuff Fatty Accumulation: A Histological Analysis

Bokshan, S; Tabarastani TQ; Ruderman L; Rueckert H; Levin J; Hilton M; Ankawenze, O

Background

Fatty deposition in the rotator cuff has been associated with shoulder dysfunction, risk of repair failure, and poor post-operative outcomes. While many studies have assessed this fatty transformation based on magnetic resonance imaging, this study sought to assess patient risk factors associated with true fatty deposition based on histological analysis.

Methods: Supraspinatus muscle biopsies were obtained from 51 patients undergoing arthroscopic rotator cuff repair in a prospective manner. Biopsies were examined using LipidTox staining to visualize and quantify lipid accumulation, and patients were broken into a fatty and non-fatty rotator cuff group based on this. Patient demographics as well as surgical variables were collected to assess which factors had the largest impact on fatty accumulation.

Results

A total of 51 patients were included with a mean age of 60.1 years (SD: 10.5 years). There were 19 high grade partial, 10 small, 7 medium, 10 large, and 5 massive tears. In the univariate analysis, patients with fatty RTC were 63.2 years-old on average compared to 59.7 years-old in the non-fatty group ($p = 0.038$). Females made up 57.1% of the fatty cohort which was statistically greater compared to the non-fatty group ($p = 0.042$). Large tear sizes were significantly more likely to occur in the fatty group ($p = 0.005$). In the multivariate analysis, full tendon tear (as opposed to high grade partial) status had the largest predictive status of falling in the fatty RTC group (odds ratio of 15.4, $p = 0.008$), followed by female sex (odds ratio: 4.9, $p = 0.036$). Patients in the fatty RTC group had significantly higher ASES score ($p = 0.048$) and lower VAS scores ($p = 0.002$).

Conclusion: Both female sex and full thickness tears were identified as significant risk factors for increased cellular lipid accumulation in patients undergoing rotator cuff repair. Postoperative patient-reported outcomes and pain scores both improved in the cohort with increased fatty accumulation.

Association Between Achilles Tendinopathy and Metabolic Disease: A Systematic Review

Gick, S; Ceraulo, A; Eckensweiler, L; Cook, C; Hendren, S

Purpose

Current literature investigation indicates that tendinopathies occur at a higher rate in metabolic diseases, including Type II Diabetes (DM), Hypertension (HTN), Hyperlipidemia (HLD), and Obesity. It has been shown that there is increased thickness of the Achilles tendon at the midportion in subjects with DM and HLD. Previous studies indicate that there is an increased prevalence of DM in patients with Achilles Tendinopathy (AT) and with tendon ruptures. There is evidence that adiposity is a risk factor for tendinopathies by its increased yield on load bearing tendons and the speculative biochemical alterations from systemic dysmetabolic factors. Increasing evidence suggests that obesity is a risk factor in developing AT, creating a low level of inflammation that results in increased cytokines and tenocytes. A recent systematic review suggested a positive association between HLD and rotator cuff disease, however, most previous studies on the association of AT and HLD have been small cohorts or case-control studies. Fewer studies have been completed to assess the association between HTN and AT, but these have considered hypertension to cause a change of the vascular composition leading to altered circulation to the Achilles tendon. Metabolic Syndrome encompasses DM, HTN, and HLD. The American Heart Association defines Metabolic Syndrome as three or more of the following: high blood glucose, high levels of triglycerides, low levels of HDL, high blood pressure, and large waist circumference. Overall, there is limited literature evaluating the association of AT and Metabolic Syndrome. Due to these findings, we reviewed the current literature on the association between symptomatic Achilles tendinopathy and metabolic disease. Our objective was to focus on the disease components of Metabolic Syndrome, specifically DM, HTN, and HLD, to determine the association with symptomatic AT.

Methods and Study Design

A systematic review and analysis were undertaken using four medical databases (MEDLINE, EMBASE, CINAHL Complete, and Scopus) from inception to February 2022. Reference checking methods were used to identify English articles that considered Achilles tendinopathy, diabetes, hypertension, hyperlipidemia, and obesity. The overall quality of each included study was determined using the Newcastle-Ottawa Scale (NOS). Cross-sectional studies, case-control studies, and cohort studies were considered for this review. The inclusion criteria comprised a human study sample, symptomatic AT, and a medical history of metabolic disease, including DM, HTN, HLD, or obesity. Studies were excluded if they contained study samples not consistent with symptomatic AT and medical history not consistent with DM, HTN, HLD or obesity. Acute Achilles tendon rupture was also excluded. Data was collected in the form of a 2-way contingency table for analysis. Outcomes were measured in terms of odds ratios, 95% confidence intervals, and p values. Study characteristics and NOS quality assessment for risk of bias is provided in Table 2 and Table 3 below.

Results

Three case-control studies met the inclusion criteria. No studies met inclusion criteria with accessible data for obesity. The total number of individuals across the studies was 516, of which 237 (46%) were experiencing AT. Amongst all six analyses, three had an OR>1. However, there was only one analysis that reported a statistical significance, as according to a p value <0.05. Five analyses reported no statistical significance. Abate et al reported an OR 2.154 (95% CI 0.504 to 9.208, p=0.292) for DM and an OR 0.819 (95% CI 0.340 to 1.969, p=0.655) for HTN. Kraemer et al reported an OR 0.544 (95% CI 0.108 to 2.755, p=0.456) for DM, an OR 0.782 (95% CI 0.346 to 1.769, p=0.555) for HTN, and OR 1.383 (95% CI 0.551 to 3.474, p=0.489) for HLD. Klemp et al reported an OR 13.222 (95% CI 3.843-45.494, p<0.001). A meta-analysis performed on each separate disease (DM, HTN, and HLD) was precluded as it demonstrated significant heterogeneity due to different populations and standardizations in each study. A meta-analysis was performed on each study separately to assess for Metabolic Syndrome. This was also precluded for significant heterogeneity due to variable data.

ABSTRACTS

Relationships between subjective player readiness, field performance metrics, and game day countermovement jump performance in collegiate male soccer players.

Otley TJ; Siesel T; Lentz, T; Poehlein E; Green C; Pietrosimone L

Purpose

Countermovement jump (CMJ) performance metrics such as reactive strength index-modified (RSI-mod) have been utilized in assessing explosiveness and neuromuscular readiness for performance (Kipp, 2016). The purpose of this study is to determine whether external load and self-reported wellness variables predict game-day RSI-mod in collegiate male soccer players during a single competitive season.

Methods

A prospective cohort of 26 male collegiate soccer players was assessed throughout 13 non-consecutive weeks (home/local game weeks) of the fall 2021 season.

Players completed 3 CMJs approximately 2 hours before each game. RSI-mod was recorded from the CMJ using VALD Force Decks (VALD, Newstead QLD, Australia) as the ratio between jump height and time to take-off[LP1]. Game day and weekly external load data (total player load, high-speed distance, and explosive efforts) was collected utilizing standard methods of torso-mounted Catapult GPS Tracking (Catapult, Melbourne, Australia). Players completed daily subjective questionnaires using a digital smartphone-based survey to assess rate of perceived exertion (RPE), physical preparedness (sleep quantity (# hours/night)), and perceptual wellbeing (stress, soreness[LP2]).

Univariable linear mixed effects models were run with RSI-mod as the outcome variable and each respective external load and wellness [LP3] [TO4] variable as the predictor. Repeated measures taken on each game day were analyzed, accounting for the collinearity of outcome variables within each player. Game day status (full go, rehab, or out) was included as a covariate in all models. An aggregate player-level summary of daily-collected biometric data on each game day was assessed using between-game averages (the average of values collected on days between each respective game day and the game day immediately prior was treated as the predictor value for that day).[LP5]

Categorical predictors were treated as ordinal to be able to create aggregate summaries. Least Square Mean differences and 95% Confidence Intervals for each predictor were provided. P-values for regression coefficients have not been adjusted for multiple testing at this time due to the exploratory nature of the study. All statistical analyses were conducted in SAS 9.4 (Cary, NC). Statistical significance was assessed at $\alpha = 0.05$.

Results

There were twenty-six participants in this study. Mean age = 19 years old with range 17-22), mean weight 75.6 +/- 8.2 kg, mean height = 180.8 +/- 5.2 cm. Positions were defenders (n = 10), midfielders (n = 9), forwards (n = 4), and goalkeepers (n = 3). A 100-unit increase in average total player load between games was associated with a 0.01-point increase in RSI-mod score adjusting for status on game day (95% CI: 0.001, 0.019; P = 0.023). A 1-unit increase in average RPE between games was associated with a 0.006-point increase in RSI-mod score adjusting for status on game day (95% CI: 0.001, 0.011; P = 0.022). Additionally, a 1-unit increase in average RPE on all days prior to a game was associated with a 0.012-point increase in RSI-mod score adjusting for status on game day (95% CI: 0.000, 0.024; p = 0.045). No other associations were statistically significant at the 0.05 level.

ABSTRACTS

Conclusions

While there were changes in RSI-mod related to increases in player load and RPE, the change in RSI-mod is very small and is not considered to be clinically significant. Recommendations for future studies are to continue with the between-game average approach to analysis and further categorize variables (such as low, moderate, and high) to better reflect how and in which situations change in predictor variables are occurring.

Clinical Relevance

This study aimed to help identify the relationship between wearable and wellness biomarkers and game day readiness. The findings will help guide methodological approaches in future studies.

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