



Contact: Lisa Weisenberger, AOSSM Director of Communications at 847/655-8647 or e-mail lisa@aossm.org

EMBARGOED FOR RELEASE UNTIL SATURDAY, MARCH 5 at 6:00 AM EST

Gene Variation in Athletes Might Signify Longer Recovery Following Concussion

Orlando, FL –Genetic research on concussions is progressing in many different avenues. However, researchers presenting their work at the American Orthopaedic Society for Sports Medicine’s (AOSSM) Specialty Day, believe there may be a new genetic connection regarding recovery rates following a sports-related concussion.

“Athletes carrying a specific genotype (CACNA1E rs704326) in our study were found to have a much greater risk of a prolonged recovery following concussion,” said lead author, Jane McDevitt, PhD from Temple University in Philadelphia. “Athletes who also reported having balance issues/deficits were also more likely to take a longer time to recover.”

McDevitt and her team analyzed information from 40 athletes with a diagnosed concussion from a hospital concussion program. Researchers further evaluated the concussion injury characteristics, acute signs, symptoms and then objective screenings, such as vestibular ocular assessments, balance error scoring, and Immediate Post-Concussion Assessment and Cognitive Testing exam. In addition, study participants provided a salivary sample to isolate certain DNA.

“We need to perform additional research but we think there may be a connection between the genetic proteins and the increase of calcium which leads to the deficits in recovery,” said McDevitt.

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Rise in Lower Extremity Injuries Possible Result of New Concussion Prevention Rules in NCAA Football

Orlando, FL – NCAA tackling rule changes that penalize head to head contact, and encourage tackling of the lower extremity have had some proven impacts in collegiate football.. However, according to researchers presenting their work at the American Orthopaedic Society for Sports Medicine’s (AOSSM) Specialty Day, an unintended consequence of these rule changes may be higher rates of knee, ankle and thigh injuries.

“Nearly a third of all concussions in collegiate athletics occur during football. With the relatively recent rule changes, concussion rates have not decreased. Our analysis of the NCAA Injury Surveillance Database though noted increased rates of ankle and knee injuries, which may result in osteoarthritis and disability issues later in life for these athletes,” said lead author, Robert Westermann, MD from the University of Iowa. “Athletes may be making contact lower on the body, to avoid the head-to-head contact and thus stiffer game penalties.”

Westermann and his team looked at the NCAA Injury Surveillance Database for 57 programs and compared injury rate ratios between 2009/10-2011/12 and after new rules to reduce head to head tacking between the 2012/13-2014/15 seasons. Lower extremity injuries (i.e. hip/groin, upper leg/thigh, knee, lower leg/Achilles, foot/toes) and sports-related concussions were examined. The data for the surveillance system is collected through program athletic trainers and physicians.

Overall, 2,400 lower extremity injuries were reported during those time periods, with the most occurring to the knee (33.6%) and ankle (28.6%). Fifty-nine percent of the injuries were due to player contact. Non-contact/overuse injuries did not increase during the time studied.

“Our research is the first to report trends in injury patterns since “targeting” rule changes took effect. Continued surveillance to examine these trends, and a more in-depth examination of how targeting rule changes are impacting injuries both at the targeted site and at other parts of the body needs to be performed to prevent long-term health issues,” said Westermann.

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Single-bundle ACL Reconstruction Offers Positive Results for Patients

Orlando, FL – Single and double-bundle techniques may provide similar outcomes in patients undergoing ACL reconstruction, as noted in research presented today at the American Orthopaedic Society for Sports Medicine’s (AOSSM) Specialty Day. The study shows patients in both groups demonstrate similar performance during recovery.

The original research group included 105 patients (33 women, 70 men) ranging in age from 18-52 years old. A total of 87 patients were available for the 5-year follow-up and were included in the study. All patients underwent post-operative rehabilitation under the same guidelines and supervision of physical therapists. Follow-up exams included multiple subjective and objective evaluation tests, including range of motion (ROM), one-leg-hop test, square-hop test, and knee injury osteoarthritis outcome score (KOOS).

.Patients treated with single or double-bundle ACL reconstruction showed no significant difference in major performance tests,” noted lead author Ioannis Karikis from NU Hospital Group in Uddevalla, Sweden. “Most notably, 89% of the single-bundle and 84% of the double-bundle groups had a negative pivot-shift test, suggesting both groups had similar knee stability and health.”

“While several studies have shown double-bundle ACL reconstruction is preferable over single-bundle, our research suggests both may be successful surgical approaches for patients,” commented Karikis. “If nothing else, the double-bundle technique did not offer better performance for patients recovering from ACL surgery.”

The study also noted that the presence of osteoarthritis (OA) in patients was similar during follow-up evaluations, regardless of technique used during ACL surgery.

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Graft Choice in ACL Reconstruction Important for Surgeons, Patients

Orlando, FL – Using soft tissue allografts (cadaver tissue) in ACL reconstructions may increase the risks for a revision reconstruction postoperatively, according to research presented today at the American Orthopaedic Society for Sports Medicine’s (AOSSM) Specialty Day. The study adds to research demonstrating that the bone-patellar tendon-bone (BPTB) autograft (graft harvested from the surgical patient) remains a strong choice for these surgeries.

“Our research looked at 14,105 cases of ACL reconstruction, including cases with bone-patellar tendon-bone autografts, hamstring autografts, and soft tissue allografts,” noted lead author Gregory B. Maletis, MD, from Kaiser Permanente in Baldwin Park, California. “Compared to bone-patellar tendon-bone autografts, allografts processed with <1.8 Mrads irradiation had a more than 2 times higher risk of revision, and grafts processed with ≥ 1.8 Mrads or high pressure chemical processing had a more than 4-6 times higher risk of revision. This was true even after adjustments for age, gender, and race.”

Data for the study was collected from the Kaiser Permanente ACLR Registry. Of the cases analyzed, 4,557 (32.5%) involved bone-patellar tendon-bone autografts, 3,751 (26.8%) soft tissue allograft, and 5,707 (40.7%) hamstring allograft. After a 3-year follow-up, the overall revision rates were 2.5% for BPTB, 3.5% for hamstring autografts, and 3.7% for soft tissue allografts. A time dependent relationship was identified with more highly processed allografts undergoing revision at earlier time frames than less processed allografts. Non-processed soft tissue allografts were not found to have a statistically significantly different risk of revision compared to BPTB autografts.

“Our research showed that when soft tissue allografts were used, those processed with chemicals or irradiation had an increased risk of revision surgery when compared to bone-patellar tendon-bone autografts,” Maletis commented. “These points should be considered by surgeons when shaping surgical decisions to ensure the best possible recovery and future health of patients.”

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Fatigue Contributing Factor in Kid's Pitching Injuries

Orlando, FL – Shoulder and elbow injuries in adolescent pitchers are becoming more and more prevalent each year. Researchers presenting their work today at the American Orthopaedic Society for Sports Medicine's (AOSSM) Specialty Day, highlight how fatigue can affect pitching mechanics and potentially result in injuries.

“Our study simulated a 90-pitch game for 28 elite, adolescent pitchers and investigated how their shoulder and elbow motions affected pitching speed, accuracy, pain, and pitching mechanics. As expected, the boys became progressively more fatigued and painful with additional pitches. We also found that their pitching mechanics changed, which may ultimately contribute to injury” said lead author, Peter Chalmers, MD from Rush University Medical Center, in Chicago.

Study participants ranged in age between 13-16 years of age, had been pitching for approximately 6 years and pitched an average of 94 pitches per week. Shoulder range of motion was assessed before and after each game. Speed and accuracy were measured for every pitch and every 15th pitch was videotaped. Perceived fatigue and pain were assessed after each inning.

“Through our analysis of pitching mechanics, it was noted that core and leg strength may be a key component of fatigue and ultimately injury in pitchers. As pitchers became fatigued, trunk rotation timing began to falter and pain increased. We hope that with additional research, we can work towards programs to help build strength and prevent these shoulder and elbow pitching injuries,” said Chalmers.

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New Procedure for Massive Rotator Cuff Tears Restores Stability Better, Say Researchers

Orlando, FL –Repairing massive rotator cuff tears is often a tricky proposition, especially for those who have failed prior surgery. Researchers presenting their work at the American Orthopaedic Society for Sports Medicine’s (AOSSM) Specialty Day today, discussed how a new arthroscopic procedure to treat large rotator cuff tears may help patients return to sports and work quicker.

“Our work on utilizing an arthroscopic superior capsule reconstruction (ASCR) restored shoulder function at a greater rate than previous forms of treatment and helped return our patients to recreational sport and work faster,” said Teruhisa Mihata, MD, PhD from the Osaka Medical College

From 2007-2014, Mihata and his team followed and treated 100 ASCR patients with an average age of 66 years. All of the individuals had irreparable rotator cuff tears that had failed previous treatment. Physical exams, x-rays and MRI were performed prior to surgery and also again at three, six and 12 months following surgery and yearly thereafter. Return to sport and work rates were also analyzed in 34 patients who were employed and 26 patients who were recreational athletes prior to injury.

The average postoperative outcome scores for 92% of these individuals all improved their strength and shoulder function significantly. Thirty-two patients returned fully to their previous work and two patients returned with reduced hours and workloads. All 26 patients who played sports prior to injury returned fully to their activities.

“Our positive results suggest that this procedure is a viable option for irreparable, large rotator cuff tears. We hope to perform additional research to further solidify our results,” said Mihata.

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Young Baseball Players Could Benefit from Preseason Arm Injury Prevention Programs

Orlando, FL – Preseason prevention programs are beneficial to young baseball pitchers, according to research presented today at the American Orthopaedic Society for Sports Medicine’s (AOSSM) Specialty Day. The study, the first to analyze a well-monitored preseason training program, showed numerous arm flexibility and strength improvements in participating athletes that could ultimately diminish the risk of injuries.

“Pitchers participating in this targeted prevention program demonstrated reduced internal rotation (IR) and horizontal adduction (HA) deficits,” commented corresponding author Charles A. Thigpen, PT, PhD, ATC, from ATI Physical Therapy in Greenville, South Carolina. “Improvements in these performance areas are important, as similar deficits have been linked to arm injuries in previous research.”

The study group included 143 pitchers at a median age of 15.7, of which 88 participated in additional preseason training and 76 continued with normal training. The prevention program was supervised by an athletic trainer and included resistance training with dumbbell weights and elastic tubing, as well as a focused flexibility program. This required an approximately fifteen minute commitment from pitchers, 4 times a week.

“Pitchers are most affected by arm injuries, in particular those who have had a prior injury,” noted Thigpen. “If we can encourage parents, coaches, and youth baseball organizations across the country to adopt similar programs, athletes may have a better chance for reducing time off the field because of injury, especially considering the increased effectiveness of the program in preventing subsequent arm injuries.”

Pitchers who had previous injuries and participated in the preseason training program were 4 times less likely to suffer an injury than those in the general arm care program. Further studies with follow-up are needed to confirm the benefits of these programs.

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Paper 01:

Abstract Title:

A Comparison of Anatomic Double and Single-bundle Techniques for Anterior Cruciate Ligament Reconstruction, A Prospective Randomized Study with a 5-year Follow-up

Authors:

Ioannis Karikis, MD¹, Neel Desai, MD², Ninni Sernert, PhD³, Lars Rostgard-Christensen, MD⁴, Juri T. Kartus, MD, PhD⁵.

¹NU-Hospital Group, Uddevalla, Sweden, ²Sahlgrenska University Hospital, Mondal, Sweden,

³Development of Research and Development, USA, ⁴Skaraborg Hospital, Lidköping, Sweden, ⁵Norra Dlivsborgs Ldnssjukhus, Trollhattan, Sweden.

Objectives: The purpose of this study was to compare the mid-term outcome after arthroscopic anterior cruciate ligament (ACL) reconstruction with either the anatomic double-bundle (DB) or anatomic single-bundle (SB) technique using hamstring tendon autografts in an unselected group of patients.

Methods: 103 patients (33 women, 70 men; median age, 27 years; range, 18-52 years) were randomized and underwent ACL reconstruction (DB group; n=53 and SB group; n=50). All reconstructions were performed anatomically, identifying the ACL footprints, using the anteromedial portal for the femoral tunnel drilling and utilizing interference screw for tibial and femoral fixation. One blinded observer examined the patients both preoperatively and at follow-up (median, 64 months; range, 55-75 months). Radiographic evaluation of OA was performed using the Ahlbäck, Kellgren-Lawrence and Fairbanks grading systems in the early postoperative period and at follow up.

Results: Preoperatively, no differences were found between the study groups apart from the pre-injury Tegner activity level, which was lower in the DB group ($p=0.02$). Eighty-seven patients (83%) were available for examination at 5-year follow-up. There were no significant differences between the groups in terms of the pivot-shift test, KT-1000 arthrometer laxity measurements, manual Lachman test, One-leg-hop test, Square-hop test, range of motion, Lysholm knee scoring scale, Tegner activity scale and Knee Injury and Osteoarthritis Outcome Score (KOOS). Correspondingly, no differences were found between the groups regarding the presence of OA at follow-up. Both DB and SB groups improved significantly at follow-up compared with the preoperative assessment.

Conclusion: At mid-term follow-up of an unselected group of patients, anatomic DB reconstruction was not superior to anatomic SB reconstruction in terms of the pivot-shift test or subjective and objective outcome variables, as seen in this prospective randomized study. Furthermore, there was no difference in terms of the presence of OA at follow-up.

Paper 02

Abstract Title:

Increased Risk of Revision after ACL Reconstruction with Soft Tissue Allograft Compared to Autograft: Graft Processing and Time Make a Difference.

Authors:

Gregory Maletis, MD¹, Jason Chen, MA², Maria Carolina Secorun Inacio, PhD³, Rebecca Love, MPH⁴, Tadashi Ted Funahashi, MD⁵.

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³Kaiser Permanente, San Diego, CA, USA, ⁴Kaiser Research and Evaluation, San Diego, CA, USA, ⁵Orthopedic Surgery, Irvine, CA, USA.

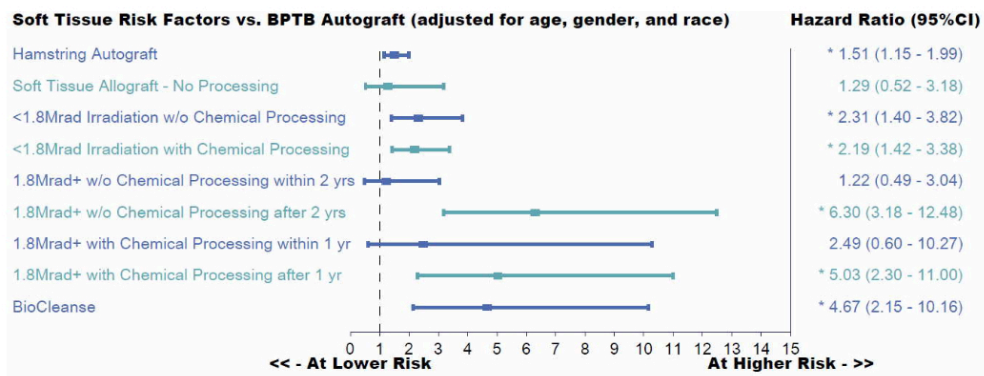
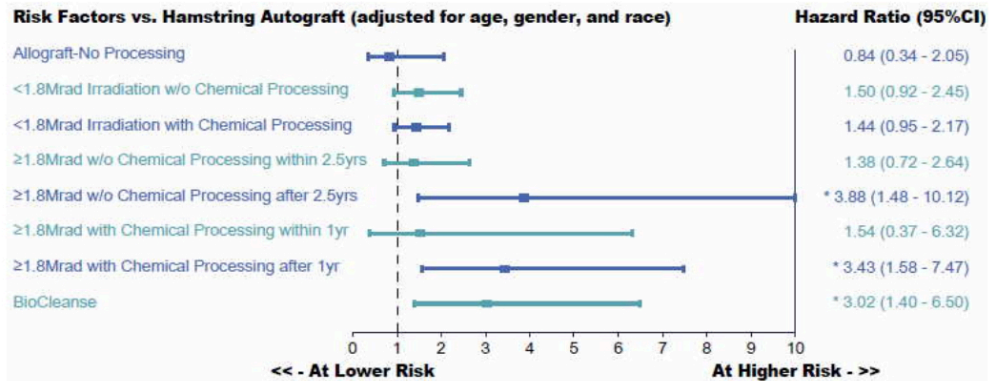
Objectives: The use of allograft tissue for anterior cruciate ligament reconstruction (ACLR) remains controversial. Numerous meta-analysis and systematic reviews of small clinical studies have not found differences between autograft and allograft outcomes but large registry studies have shown an increased risk of revision with allografts. The purpose of this study was to compare the risk of aseptic revision between bone-patellar tendon-bone (BPTB) autografts, hamstring tendon autografts and soft tissue allografts.

Methods: A retrospective cohort study of prospectively collected data was conducted using an US ACLR Registry. A cohort of primary unilateral ACLR cases reconstructed with BPTB autografts, hamstring autografts and soft tissue allografts (from any site) was identified. Aseptic revision was the end point of the study. Type of graft and allograft processing methods (non-processed, <1.8Mrads with and without chemical processing (Allowash or AlloTrue methods), ≥1.8 Mrads irradiation with and without chemical processing, and chemical processing alone (BioCleanse)) were the exposures of interest evaluated. Time from surgery was evaluated as an effect modifier. All analyses were adjusted for age, gender, and race. Kaplan-Meier curves and Cox proportional hazard models were employed. Hazard ratios (HR), 95% confidence intervals (CI) are provided.

Results: The cohort had 14015 cases, 8924 (63.7%) were male, 6397 (45.6%) were White, 4557 (32.5%) cases used BPTB autograft, 3751 (26.8%) cases used soft tissue allograft and 5707 (40.7%) cases used hamstring autograft. The median age was 34.6 years-old (IQR 24.1-43.2) for allograft cases and 24.3 years-old (IQR 17.7-33.8) for hamstring autograft cases, and 22.0 years-old (IQR 17.6-30.0) for BPTB autograft cases. Compared to hamstring tendon autografts, an increased risk of revision was found in allografts processed with ≥1.8Mrads without chemical processing after 2.5 years (HR: 3.88 95%CI 1.48-10.12), and ≥1.8Mrads with chemical processing after only 1 year (HR: 3.43 95%CI 1.58-7.47) and with BioCleanse processed grafts (HR: 3.02 95%CI 1.40-6.50). Compared to BPTB autografts, an increased risk of revision was seen with hamstring autografts (HR: 1.51 95%CI 1.15-1.99) and BioCleanse processed allografts (HR: 4.67 95%CI 2.15-10.16). Allografts irradiated with <1.8 Mrads with chemical processing (HR: 2.19 95%CI 1.42-3.38) and without chemical processing (HR: 2.31 95%CI 1.40-3.82) had a higher risk of revision as did allografts with ≥ 1.8Mrads without chemical processing after 2.0 years (HR: 6.30 95%CI 3.18-12.48) and ≥1.8 Mrads with chemical processing after 1 year (HR: 5.03 95%CI 2.30-11.0). Non-processed soft tissue allografts did not have a higher risk of revision when compared to hamstring or

BPTB autografts.

Conclusion: When soft tissue allografts are used for ACLR, both processing and time from surgery affect the risk of revision when compared to autografts. Tissue processing has a significant effect on the risk of revision surgery and that effect is most profound with more highly processed grafts and increases with time. Surgeons and patients need to be aware of the increased risks of revision with the various soft tissue allograft used for ACLR.



Paper 08

Abstract Title:

Effectiveness of a Preseason Prevention Program on Arm Injury Risk Factors: An Randomized Control Trial in Adolescent Pitchers

Authors:

Charles A. Thigpen, PT, PhD, ATC¹, Lane Brooks Bailey, DPT², Michael J. Kissenberth, MD³, Thomas J. Noonan, MD⁴, Richard J. Hawkins, MD, FRCSC³, Ellen Shanley, PhD¹.

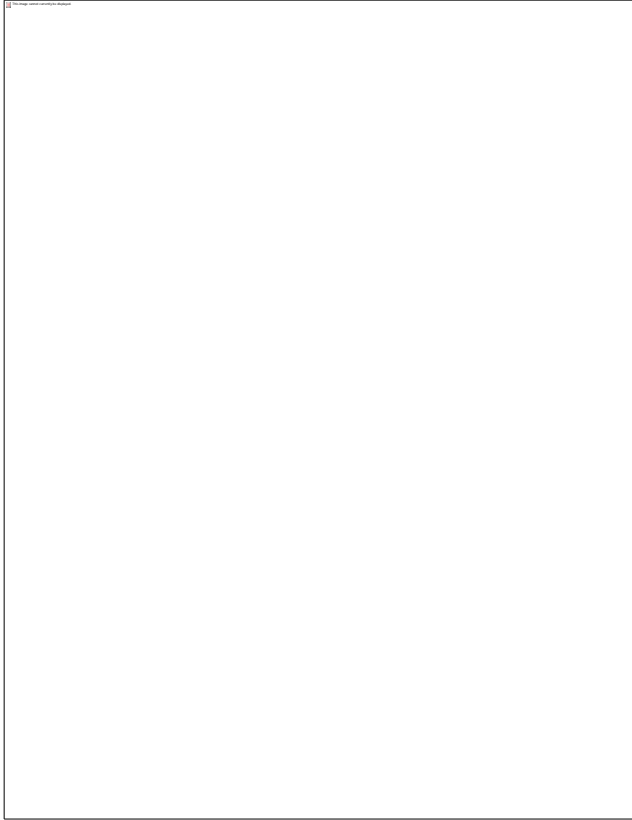
¹Proaxis Therapy, Greenville, SC, USA, ²Ironman Sports Medicine Institute - Memorial Hermann, Houston, TX, USA, ³Steadman Hawkins Clinic of the Carolinas/Greenville Health System, Greenville, SC, USA, ⁴Steadman Hawkins Clinic Denver, Greenwood Village, CO, USA.

Objectives: Deficits in posterior shoulder flexibility and strength have been identified as modifiable risk factors for pitching injuries. There are no studies showing the effect of a prevention program on arm injuries and associated risk factors such as strength and ROM. The purpose of this study was to assess the effectiveness of a preseason prevention program to resolve these deficits in adolescent pitchers.

Methods: Baseball pitchers (n=143 age=15.7±1.2; height=165.0±43.8cm; weight=72.2±12.6kg) participating in all team activities were block randomized by school to intervention (INV n=88) or control (CON n=76) groups. The INV group received an Athletic Trainer supervised posterior shoulder flexibility and strengthening program (3x/week for 8-weeks). The CON group participated in their usual training. All pitchers participated in a 4-week interval-throwing program immediate to the start of practice. Bilateral shoulder ROM and strength were assessed pre-post program using a digital inclinometer (DI) to measure supine external rotation(ER), internal rotation (IR), and horizontal adduction (HA) ROM with the scapula stabilized at 90 degrees of abduction. Standard manual muscle testing was used for strength assessments using a hand held dynamometer with arm at the side(ER-0) and in supine 90 degrees/90 degrees (ER-90, IR-90) then normalized to body weight (BW). Injuries were recorded over the subsequent baseball season. Two trials were averaged and used to calculate deficits (non-dominant-dominant) and pre-post change scores to examine the ability of the program to ameliorate baseline deficits associated with injury risk. A one-way ANOVA was used to compare change scores between groups and a 2-way ANOVA (group by injury) to examine the change scores influence on injury ($\alpha=0.05$).

Results: The INV group displayed a greater reduction in IR deficit(INV=7.3 degrees ±11;CON=1.8 degrees ±9;F(1,106)=5.1,P=0.01) P=0.05 and HA deficit(INV=3.3 degrees ±13; CON= -2.4 degrees ±11;F(1,106)=6.7,P=0.01) compared to the CON group. The INV group also maintained their dominant ER-0: IR-90 ratio (INT=-1.6 ±5%BW; CON= -3.5 ±5%BW; F (1,106) =2.1, P=0.09) compared to the CON group. There were 19 arm injuries over the subsequent season (INV=11; CON=8 arm injuries). Control group pitchers who went on to suffer an injury did not decrease their HA deficit (Uninjured=3.0 degrees ±10;Injured=-9.5 degrees ±14;F(1,106)=3.3,P=0.03) or their IR deficit went on to suffer an injury(Uninjured=-1.7 degrees ±8;Injured 8.5 degrees ±13;F(1,106)=3.8,P=0.02). There were no other differences between or among groups (P>0.05).

Conclusion: Adolescent pitchers displayed clinically meaningful improvements in posterior shoulder flexibility (HA and IR) and maintenance of their ER: IR ratio during an Athletic Trainer supervised preseason program. The improvements in HA and IR deficits were associated with decreased injury risk over the course of the subsequent high school season. Thus, a targeted pre-season program appears to be effective in improving HA deficit and impacting injury risk. Further studies are warranted to confirm our results.



Paper 09

Abstract Title:

Does Fatigue Alter Pitching Mechanics?

Authors:

Brandon J. Erickson¹, Terrance Sgroi, DPT², **Peter Nissen Chalmers, MD³**, Peter Vignona², Matthew Lesniak, DPT⁴, Charles A. Bush-Joseph, MD⁵, Nikhil N. Verma, MD⁶, Anthony A. Romeo, MD⁷.

¹Rush University, Chicago, IL, USA, ²Accelerated Rehab PT, Chicago, IL, USA, ³Rush University Medical Center, Chicago, IL, USA, ⁴Accelerated Physical Therapy, Palos Heights, IL, USA, ⁵Rush University Medical Center Midwest Orthopaedics, Chicago, IL, USA, ⁶Rush Presbyterian St. Luke's Medical Center, Chicago, IL, USA, ⁷Midwest Orthopaedics, Chicago, IL, USA.

Objectives: Background: Injuries of the adolescent shoulder and elbow are common in baseball pitchers. Fatigue has been demonstrated to be a risk factor for injury.

Purpose: To determine if shoulder and elbow kinematics, pitching velocity, accuracy, and pain change during a simulated full baseball game in adolescent pitchers.

Methods: Methods: Adolescent pitchers between the ages of 13-16 were recruited to throw a 90 pitch simulated game. Shoulder range of motion was assessed before and after the game. Velocity and accuracy were measured for every pitch and every 15th pitch was videotaped from two orthogonal views in high definition at 240 Hz. Quantitative and qualitative mechanics were measured from these videos. Perceived fatigue and pain were assessed after each inning using the visual analog scale. Data was statistically analyzed using a repeated-measures analysis of variance.

Results: Results: Twenty-eight elite adolescent pitchers were included. These pitchers, on average, were 14.6±0.9 years old (mean ± standard deviation), had been pitching for 6.3±1.7 years, and threw 94±58 pitches per week. Our experimental model functioned as expected in that pitchers became progressively more fatigued and painful and pitched with a lower velocity as pitch number increased ($p < 0.001$, 0.001, and < 0.001 respectively). Knee flexion at ball release progressively increased with pitch number ($p = 0.008$). Hip and shoulder separation significantly decreased as pitch number increased, from 90%±40% at pitch 15 to 40%±50% at pitch 90 ($p = 0.271$ in all cases, 91% power for elbow flexion at ball release). External rotation and total range of motion in the pitching shoulder significantly increased post-pitching ($p = 0.007$ and 0.047 respectively).

Conclusion: Conclusion: As pitchers progress through a simulated game they throw lower velocity pitches and become fatigued and painful. Core and leg musculature becomes fatigued before upper extremity kinematics change. Based upon these results, the authors hypothesize that core and leg strengthening may be valuable adjuncts to prevent upper extremity injury.

Paper 15

Abstract Title:

Unintended Consequences of Concussion Prevention in NCAA Football

Authors:

Robert W. Westermann, MD¹, Peter Wehr, MD¹, Annunziato Amendola, MD².

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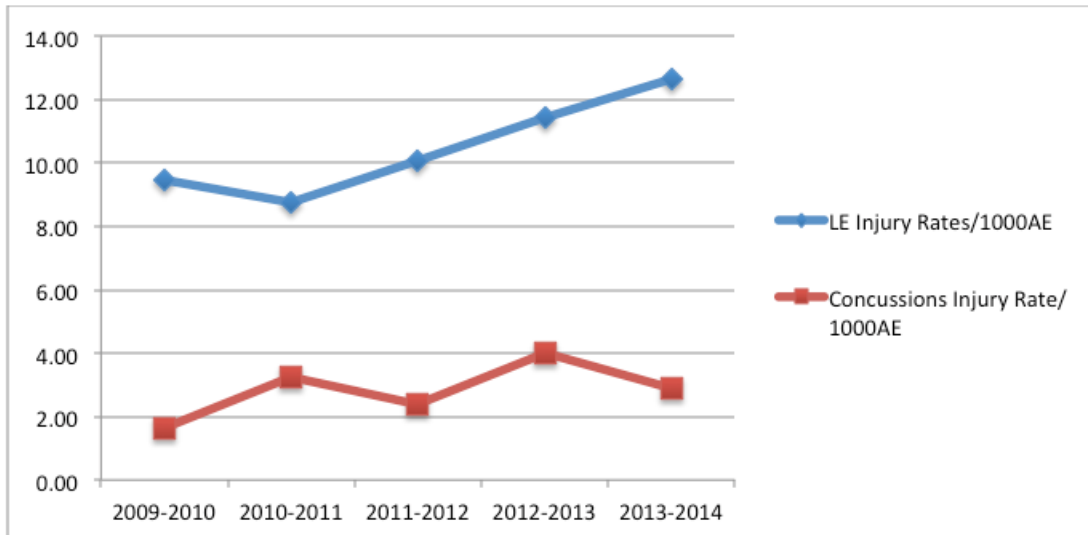
Objectives: Both lower extremity and head injuries are common in American Football players. Concussions, or Mild Traumatic Brain Injuries (MTBIs), have gained increased interest in the past decade. Recurrent MTBIs have been associated with late-life cognitive impairment and depression in American Football populations.^{2, 3} beginning in 2008, the NCAA introduced rule changes with the intent to halt or reverse the increasing rates of MTBIs in its players. Lower-extremity injuries in American football populations have been associated with increased rates of post-traumatic osteoarthritis¹ and significantly contribute to disability in retirement. While lower extremity injury rates have been studied and associated with weather⁵ and playing surface⁴, no such study has sought an association between lower extremity injury with the timing/introduction of rule changes used to prevent head injuries. The purpose of this study was to assess if lower extremity injury rates are increasing after concussion rule changes. We hypothesize that there may be a compensatory increase in lower extremity injury rates as players act to avoid head-to-head contact and comply with instated rules.

Methods: The NCAA Injury Surveillance System (NCAA ISS) database was queried for in-game injuries suffered between 2009-2014. All injuries suffered by NCAA Football players that occurred in competition were identified. Injuries that did not result in lost participation time were excluded. Lower extremity injuries that resulted in lost time included injuries to the thigh/upper leg, knee, lower leg/Achilles, ankle and foot. All concussions resulting in lost time were also identified during the same time period for comparison. Data regarding athletic exposures was collected in order to calculate the incidence of injury.

Results: Between 2009 and 2014, 48 NCAA Football programs provided data on 123 team-seasons to the NCAA ISS for analysis. The incidence of lower extremity injuries increased from 9.45 injuries per 1000AE in the 2009-2010 season to 12.63 injuries per 1000AE in the 2013-2014 season. The rate of concussions suffered by American Football players, during the same time period, did not significantly change (1.64 concussions per 1000AE's in 2009-2010 season versus 2.87 concussions per 1000 AE's in the 2013-2014 season) [Graph 1].

Conclusion: Given heightened societal interest in concussions, the NCAA has implemented several rule changes in order to influence how American Football is played. Since the initiation of these rule changes, concussion rates have remained stable. During our study period, injuries to the lower extremity have increased. In order to comply with avoiding head-to-head contact, players may be targeting the lower extremities. This is concerning as lower extremity injuries and post-traumatic osteoarthritis are common causes of disability in retired American Football players.

Graph 1: The incidence of lower extremity (LE) injuries versus the incidence of concussions in NCAA American Football between 2009-2014.



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Paper 16

Abstract Title:

CNS Voltage-gated Calcium Channel Gene Variation And Prolonged Recovery Following Sport-related Concussion

Author:

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Objectives:

To examine the association between concussion duration and two calcium channel, voltage-dependent, R type, alpha 1E subunit (CACNA1E) single nucleotide polymorphisms (i.e., rs35737760 and rs704326). A secondary purpose was to examine the association between CACNA1E single nucleotide polymorphisms (SNPs) and three acute concussion severity scores (i.e., vestibule-ocular reflex test, balance error scoring scale, and Immediate Post-Concussion Assessment and Cognitive Testing).

Methods: Forty athletes with a diagnosed concussion from a hospital concussion program completed a standardized initial evaluation. Concussion injury characteristics, acute signs and symptoms followed by an objective screening (i.e., vestibular ocular assessments, balance error scoring system test, and Immediate Post-Concussion Assessment and Cognitive Testing exam) were assessed. Enrolled participants provided salivary samples for isolation of DNA. Two exon SNPs rs35737760 and rs704326 within CACNA1E were genotyped.

Results: There was a significant difference found between acute balance deficits and prolonged recovery group ($X^2 = 5.66$, $p = 0.017$). There was an association found between the dominant model GG genotype ($X^2 = 5.41$, $p = 0.027$) within the rs704326 SNP and prolonged recovery group. Significant differences were identified for the rs704326 SNP within the dominant model GG genotype ($p = 0.030$) for VOR scores by recovery. A significant difference was found between the rs704326 SNP codominant model AA ($p = 0.042$) and visual memory. There was an association between acute balance deficits and prolonged recovery ($X^2 = 5.66$, $p = 0.017$) for the rs35737760 SNP. No significant associations between concussion severity and genotype for rs35737760 SNP.

Conclusion: Athletes carrying the CACNA1E rs704326 homozygous genotype GG are at a greater risk of a prolonged recovery. Athletes that reported balance deficits at the time of injury were more likely to have prolonged recovery. These polymorphisms within CACNA1E could alter the CACNA1E protein and allow for an increase of calcium leading to deficits to the granule cells within the brain.

Paper 18

Abstract Title:

Arthroscopic Superior Capsule Reconstruction for Irreparable Rotator Cuff Tears: A Prospective Clinical Study in 100 Consecutive Patients with 1 To 8 Years of Follow-up

Authors:

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Objectives: An arthroscopic superior capsule reconstruction, in which the fascia lata autograft attached medially to the superior glenoid and laterally to the greater tuberosity, restores shoulder stability and muscle balance in patients with irreparable rotator cuff tears; consequently, it improves shoulder function specifically deltoid muscle function and relieves pain. We assessed the clinical outcome of arthroscopic superior capsule reconstruction (Figure 1) in 100 consecutive patients with irreparable rotator cuff tears. Specifically, we focused on the rates of return to sport and work.

Methods: From 2007 to 2014, we performed arthroscopic superior capsule reconstruction on 107 consecutive patients (mean 66.7 years; range, 43 to 82) with irreparable rotator cuff tears that had failed conservative treatment. Seven patients were lost to follow-up because of other medical problems or reasons. In the remaining 100 patients there were 56 supraspinatus and infraspinatus tears; 39 supraspinatus, infraspinatus, and subscapularis tears; 3 supraspinatus, infraspinatus, teres minor, and subscapularis tears; and 2 supraspinatus, infraspinatus, and teres minor tears. Physical examination, radiography, and MRI were performed before surgery; at 3, 6, and 12 months after surgery; and yearly thereafter. Rates of return to sport and work were also investigated in those patients who had been employed (34 patients: 21 manual workers, 10 farmers, 1 butcher, 1 cook, and 1 athletic trainer) or played sport (26 patients: 6 golf, 4 table tennis, 4 swimming, 3 martial arts, 2 baseball, 2 yoga, 1 tennis, 1 badminton, 1 skiing, 1 mountain-climbing, and 1 ground golf) before injury.

Results: The average preoperative American Shoulder and Elbow Surgeons (ASES) score was 31.6 points (range, 3.3 to 63.3 points) and the average Japanese Orthopaedic Association (JOA) score was 51.6 points (26.5 to 68.5 points). Average postoperative clinical outcome scores all improved significantly at final follow-up (mean, 36.6 months after surgery; range, 12 to 96 months; ASES, 93.3 points; JOA, 92.2 points) ($P < .00001$). Ninety-two patients (92%) had neither graft tear nor re-tear of the repaired rotator cuff tendon during the follow-up period (5 to 8 years of follow-up, 17 patients; 3 to 4 years of follow-up, 19 patients; 1 to 2 years of follow-up, 56 patients). Postoperative clinical outcome scores and active elevation at final follow-up were significantly better in healed patients (ASES, 95.5 points; JOA, 93.7 points, $154.8^\circ \pm 24.2^\circ$) than in unhealed patients suffering from graft tear or re-tear of the repaired rotator cuff tendon (ASES, 76.3 points, $P < 0.0001$; JOA, 79.5, $P < 0.001$; $115.0^\circ \pm 41.8^\circ$, $P < 0.001$).

Thirty-two patients returned fully to their previous jobs, whereas two patients returned with reduced hours and workloads. All 26 patients who had played sport before their injuries returned fully to their previous sports, although most of the patients had been playing at recreational level before their injuries.

Conclusion: Arthroscopic superior capsule reconstruction restored shoulder function and resulted in high rates of return to recreational sport and work. Graft tear or re-tear of the repaired rotator cuff tendon exacerbated the clinical outcome after superior capsule reconstruction. These results suggest that arthroscopic superior capsule reconstruction is a viable surgical option for irreparable rotator cuff



tears, especially in patients who work and enjoy sport.