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Predictors of Poor Outcome Following ACL Reconstruction With or Without Lateral Extra-articular Tenodesis: The STABILITY Trial

D. Bryant,*,† A. Getgood,*,‡ R. Litchfield,*,‡ R. McCormack,§,¶ D. Boyer,§,¶ M. Heard,‖,** and P. MacDonald,††,‡‡ STA-BILITY Study Group

*Affiliations: *Fowler Kennedy Sport Medicine Clinic; †School of Physical Therapy, Western University; ‡Department of Surgery, Schulich School of Medicine and Dentistry, Western University; §Department of Orthopedics, University of British Columbia; ¶New West Orthopaedic & Sports Medicine Centre; ‖Deparment of Surgery, University of Calgary; **Banff Sport Medicine; ††Department of Surgery, University of Manitoba; and ‡‡Pan Am Clinic.*

Objective: To investigate which morphological and physical factors predict failure post ACL Reconstruction (ACLR).

Design: Multicenter randomized clinical trial.

Intervention: Logistic regression to determine variables that influence outcome within patients entered into a randomized clinical trial comparing ACLR with or without lateral extra-articular tenodesis (LET).

Outcome Measures: A regression analysis was performed to determine which factors would be most predictive of graft failure. The primary outcome (combined graft failure + persistent rotatory laxity, measured by an asymmetric pivot shift) was the dependent variable with the following independent variables: (1) sex, (2) treatment group, (3) age at surgery, (4) medial meniscus status, (5) lateral meniscus status, (6) Beighton score, (7) presence of knee hyper-extension, and (8) pivot shift under anesthesia.

Results: Six hundred twenty-four patients, 293 male, were randomized with a mean age of 18.9 (range, 14-25). At 2 years post-operative, 104/252 (41%) of ACLR alone patients suffered the primary outcome compared to 61/252 (25%) of the ACLR + LET patients. Thirty-nine patients had suffered graft rupture, 28/252 (11%) in the ACLR group compared to 11/242 (4.5%) in the ACL + LET group. The most significant predictor of failure was the group allocation that is ACLR alone or ACLR + LET, with ACLR alone having an odds of failure about 2 times greater than those who got the LET (OR, 2.1; 95% CI, 1.4-3.0; $P < 0.001$). After controlling for group, for every year of age, the odds of failure was reduced by just over 5% (OR, 0.94; 95% CI, 0.93-0.96; $P < 0.001$). Compared to having no medial meniscal pathology, the odds of failure if there is a partial excision is more than 2 times greater (OR, 2.2; 95% CI, 1.2-4.3, $P = 0.01$). Sex, pivot shift grade, lateral meniscal status, Beighton score, and knee hyper-extension were not significant predictors of failure. When graft failure was used as the dependent variable, treatment group and age remained significant predictors of outcome.

Conclusions: In young patients, not performing a LET at the time of ACLR, status of the medial meniscus and younger age at the time of surgery are significant predictors of poor outcome when performing a hamstring tendon autograft, single bindle ACLR.

Evaluating the Influence of Body Checking Policy Change on Player Contact Behaviours in 15 to 17 Year Old Midget Ice Hockey Players Using Video Analysis

M. Chin,* G. Martinez, BKin,* L. Nadeau, PhD,† C. Goulet, PhD,† M. Krolikowski, MSc,*,‡ L. Palacios-Derflingher, PhD,*,§ B. E. Hagel, PhD,*,§,¶, ‖,** and C. A. Emery, PT, PhD*,‡,§,¶,‖,**

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Department of Physical Education, Faculty of Education, Laval University, Quebec City, QC, Canada; ‡Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, §Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; ¶Department of Pediatrics, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; ‖Alberta Children's Hospital Research Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; and **O'Brien Institute of Public Health, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada.*

Objective: To determine the incidence, intensity, and types of physical contacts (PC) and head contacts (HC) in Midget non-elite ice hockey players (ages 15-17) in body checking (BC) leagues compared with non-BC leagues.

Study Design: Cohort Study.

Subjects: Twenty-six Midget teams (13 games) in BC leagues (Divisions 3 and 4, representing 25% of players) and 26 Midget teams (13 games) in non-BC leagues (Divisions 5 and 6, representing 20% of players). Gameplay represented the lowest 4 out of 9 Midget divisions.

Observation Techniques: Twenty-six randomly selected Midget ice hockey games were videotaped and analyzed using Dartfish software and validated methodology, where PC were ranked on an intensity scale from 1 to 5 (levels 4-5 PC are defined as BC).

Outcome Measures: Games were analyzed to compare the frequency and type of PC, HC, both direct (HC with an opposing player) and indirect (HC with boards or stick), and other contacts (using the limbs and stick). Incidence rate ratios (# contacts/1000 player game hours) were estimated using Poisson regression (clustering by game, offset by player-minutes).

Results: Three thousand seven hundred forty-seven PC and 2095 other contacts were analyzed, where the overall rate of PC (IRR, 0.56; 95% CI, 0.48-0.65) and other contacts (IRR, 0.71; 95% CI, 0.61-0.84) were lower in the non-BC leagues.

Specifically, BC (level 4 IRR, 0.18; 95% CI, 0.10-0.33; level 5 IRR, 0.04; 95% CI, 0.01-0.31), level 2 PC (IRR, 0.55; 95% CI, 0.47-0.64), and level 3 PC (IRR, 0.22; 95% CI, 0.15-0.34) were lower in the non-BC leagues. There were no significant differences for level 1 PC (IRR, 0.85; 95% CI, 0.69-10.5). The rates of direct HC (IRR, 0.45; 95% CI, 0.32-0.63) and indirect HC (IRR, 0.24; 95% CI, 0.14-0.42) were also lower in the non-BC leagues.

Conclusions: The overall rate of PC in non-BC leagues were 44% lower in the non-BC leagues, with BC rates being 82% (level 4) and 96% (level 5) lower. Direct HC had a 55% lower rate, indirect HC a 76% lower rate, and other contacts a 29% lower rate in the non-BC leagues. These findings can inform the mechanisms for injury and concussion risk reduction strategies following BC policy changes.

Burden and Risk Factors for Patellar and Achilles Tendinopathy in Youth Basketball

Oluwatoyosi B. A. Owoeye, PT, PhD,*,† Luz Palacios-Derflingher, PhD,*,‡ Kati Pasanen, PT, PhD,*,†,§,¶ J. Preston Wiley, MPE, MD,*,¶,‖ and Carolyn A. Emery, PT, PhD*,†,‡,¶,**,††

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada; ‡Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; §Tampere Research Center of Sport Medicine, UKK Institute, Tampere, Finland; ¶McCaig Institute for Bone and Joint Health, University of Calgary, Calgary, AB, Canada; ‖Sport Medicine Centre, University of Calgary, Calgary, AB, Canada; **Department of Pediatrics, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; and ††O'Brien Institute for Public Health, Calgary, AB, Canada.*

Objective: To determine the burden-prevalence, time to tendinopathy (new cases), duration of symptoms- and risk factors for patellar and Achilles tendinopathy in competitive youth basketball players.

Study Design: Prospective cohort study.

Subjects: A total of 518 [male (n = 316, 61%) and female (n = 202, 39%)] youth basketball players (N = 63 teams, 11-18 years) participated.

Observation Technique: The Oslo Sports Trauma Research Centre Patellar and Achilles Tendinopathy Questionnaire was used to register patellar and Achilles tendinopathy in participants, through a period of 8 to 14 weeks of competitive youth basketball.

Outcome Measures: Primary outcomes included season prevalence of patellar and Achilles tendinopathy. Primary risk factors evaluated included age, sex, weight, height, previous knee injury, previous anterior knee pain, basketball specialization and use of knee and ankle brace. Odds ratios (ORs) with 95% confidence intervals (CI) were estimated using a multivariable logistic regression analysis adjusted for covariates and team clusters.

Results: Overall, the season prevalence of patellar tendinopathy was 19.1% (95% CI, 15.8%-22.8%); 23.3% (95% CI, 18.7%-28.3%) in males and 12.5% (95% CI, 8.3%-17.9%) in females. The season prevalence of Achilles tendinopathy was 4.2% (95% CI, 2.7%-6.4%); 4.1% (95% CI, 2.2%-6.9%) in males and 4.5% (95% CI, 2.1%-8.4%) in females. Median time to patellar tendinopathy onset (new cases) was 8 weeks for male players and 6 weeks for female players. Median proportion of symptom duration was 83% of average total weeks of basketball exposure for patellar tendinopathy and 75% for Achilles tendinopathy. Higher odds of PTP were demonstrated in males (OR, 2.2; 95% CI, 1.1-4.4) and having previous anterior knee pain (OR, 8.5; 95% CI, 4.6-15.7). The low prevalence recorded for Achilles tendinopathy precluded multivariable regression analysis.

Conclusions: The burden of patellar and Achilles tendinopathy is high among competitive male and female youth basketball players. Male sex and previous anterior knee pain were identified as risk factors for patellar tendinopathy. Identified risk factors may inform interventions and screening activities, as well as future research.

The Effect of a Differential Diagnosis Guide on the Knowledge of Elbow-Related Conditions

Neil Dilworth, MB BAO BCh,* Alessandro Francella, MD,† and David Lawrence MD‡

Affiliations: University of Toronto, Toronto, ON, Canada.

Objective: To determine if providing family medicine residents a differential diagnosis guide will broaden their understanding of a common musculoskeletal complaint.

Study Design: Observational.

Subjects: Fourteen family medicine residents at the University of Toronto.

Intervention: Participants completed a pre-test exercise, in which they listed their differential diagnosis for elbow pain. They were then provided with the *"Elbow Differential Guide"*, composed by sport and exercise medicine physicians. Over the following 6 weeks participants logged any elbow cases they saw in a clinical setting. At the end of the study period a post-test was conducted and the participants were again asked to list their differential diagnosis for elbow pain based on their new knowledge.

Results: A total of 14 family medicine residents were included in this study. The median number of elbow cases recorded over the six-week period was 2.0 (IQR, 1.0-2.8) and ranged from 0 to 5 cases. The most common diagnosis recorded was "lateral epicondylitis" (n = 4). The median number of elbow diagnoses listed significantly increased between the pre-test [median, 10.5; interquartile range (IQR), 8.0-12.0) and post-test (median, 14; IQR, 9.0-15.8; $P = 0.027$); however, the "number of cases seen" was not significantly associated with the absolute difference in diagnoses listed between the pre- and post-tests ($P = 0.416$).

Conclusions: This qualitative study provides evidence that the use of an educational resource has the potential to significantly increase a family medicine residents differential diagnosis of a very common primary care musculoskeletal complaint. It is our hope that from this study we can

further justify the use of other anatomically-arranged musculoskeletal differential diagnosis guides that have already been developed. Our goal is to increase the comfort and knowledge base of medical students, residents, and physicians as it pertains to musculoskeletal topics and conditions.

Sport and Exercise Medicine Differential Guide—A Musculoskeletal Differential Knowledge Translation Resource

Alessandro Francella, MD,* Neil Dilworth, MB BCh BAO,* Youssef Hegazy,† Kevin Asem, MD,‡ Alyssa Cantarutti, MD,§ Howard Chen, MD,* Ivy Cheng, MD,* Wesley Clayden, MD,§ Ryan Eardley, MD,* Leah Hillier, MD,* Sari Kraft, MD,* David Lawrence, MD,* Mark Leung MD,* Kristopher Lundine, MD,¶ Duong Nguyen, MD,‖ Tomas O'Neill, MB BCh BAO,** and Tim Rindlisbacher, MD*

*Affiliations: *University of Toronto, Toronto, ON, Canada; †York University, Toronto, ON, Canada; ‡Western University, London, ON, Canada; §University of British Columbia, Vancouver, BC, Canada; ¶University of Melbourne, Melbourne, Australia; ‖McMaster University, Hamilton, ON, Canada; and **MacQuarie University, Sydney, Australia.*

Objective: To develop an educational resource that will increase the knowledge of medical students, residents, and physicians and broaden their differential diagnosis as it pertains to sport and exercise medicine/musculoskeletal topics and conditions.

Study Design: Educational.

Methods: Twelve primary care sport and exercise medicine physicians, 3 specialists, one sport and exercise medicine residents, and one undergraduate student have developed the "Sport and Exercise Medicine Differential Guide," which provides a differential diagnosis for 14 sport and exercise medicine topics. The topics are anatomically arranged from face and head, cervical spine, shoulder, elbow, wrist, hand, thoracolumbar spine, hip, knee, ankle, foot and also includes common dermatological and environmental-related conditions. Visual aids are provided for each topic and appropriately labelled with the corresponding conditions.

Results: A complete 40-page electronic and paper copy of the differential guide has been published for distribution amongst 4 Canadian sport and exercise medicine residents as well as some select family medicine residents in Toronto, Ontario. For each topic, the guide is arranged with labelled anatomical pictures followed by a table of the corresponding differential diagnosis and subsequent columns (number of cases seen, age/gender, sport type, and comments). This was done to give the participants the ability to record clinical cases seen and determine any potential gaps in training.

Conclusions: The publishing of the Sport and Exercise Medicine Differential Guide has provided sport and exercise medicine residents the first educational resource to broaden their differential diagnosis as well as monitor cases seen. It is our hope that this will help determine gaps in sport and exercise medicine training, allowing residents and program directors to improve their clinical experiences. In the future, this guide will also be made available to all medical students, residents, and physicians alike.

Parkinson's Disease Patients Can Benefit From an On-the-Water Dragon Boat Paddling Program

Ofer Paz, BPT,* Eitan Weiss, BPT,* Esther Cheung, HBSc,† Asaph Cohen, BPT,* James Carson, MD,‡ Petra Wildgoose, MD,‡ Alexandra Rendely, MD,‡ Sharon Hassin-Baer, MD,§ and Naama Constantini, MD¶

*Affiliations: *Bachelor of Physiotherapy, Tel Aviv University, Tel Aviv, Israel; †Honours Bachelor of Science, McMaster University, Hamilton, ON, Canada; ‡Faculty of Medicine, University of Toronto, Toronto, ON, Canada; §Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel; and ¶Faculty of Medicine, The Hebrew University of Jerusalem, Jerusalem, Israel.*

Objective: To understand how an on-the-water paddling program can impact the quality of life of patients with Parkinson's Disease (PD), and to gather data to determine if this intervention should be recommended as a management strategy for patients with PD.

Study Design: Qualitative research using in-depth interviews. All interviews were audio recorded and transcribed. The transcriptions were then analyzed, coded, and examined for common themes by 2 independent reviewers.

Subjects: Seventeen patients with PD, enrolled in the dragon boat paddling program at the Daniel Rowing Center in Tel Aviv, Israel, were interviewed.

Intervention: Beginning April 2016, the Daniel Rowing Center provides weekly dragon boat paddling practices to those with PD. Each practice is 1.5 hours long, consisting of a light warm up, on-the-water paddling, and cool down stretching.

Outcome Measures: Themes elicited from PD patient interviews related to barriers or facilitators for an on-the-water paddling program to improve daily function.

Results: Several participants noted a general increase in perceived energy. The improvement in energy was felt during the activity, immediately after the activity, and after the participants returned home. Others noted considerable improvement in their quality of life: "The paddling activity gives me more strength, more energy. There is a reason to live." Many participants expressed being in superior moods after completing the activity, and shared how it contributed to positive social interactions. Additionally, improved strength and flexibility were frequently reported. Participants described how they anticipate the physical demands of the activity, are eager for it, and feel stronger and more flexible after the exercise.

Conclusions: Exercise is increasingly recognized as a therapy used to improve quality of life and alleviate symptoms experienced by patients with PD. Dragon boat paddling is a unique physical activity that combines various fitness goals while providing a whole-body workout. This study found that a dragon boat paddling program improved the quality of life, energy and strength of patients with PD. This intervention can be recommended as a management strategy for patients with PD.

The Critical Shoulder Angle Is an Effective Radiographic Parameter to Predict the Presence of Shoulder Pathologies: A Systematic Review

Gabriel N. Kuper, BHSc,* Ajaykumar Shanmugaraj, BHSc,* Nolan S. Horner MD,* Seper Ekhtiari, MD,* Nicole Simunovic, MSc,* Edwin R. Cadet, MD,† and Olufemi R. Ayeni, MD, PhD*

*Affiliations: *Division of Orthopaedic Surgery, Department of Surgery, McMaster University, Hamilton, ON, Canada; and †Raleigh Orthopaedic Clinic, Raleigh, NC.*

Objective: The purpose of this systematic review was to: (1) determine the degree of correlation between the CSA and shoulder pathologies, (2) determine the reliability of measuring CSA between (intra-rater reliability) and within (inter-rater reliability) clinicians, (3) assess the accuracy of different imaging modalities used for measuring the CSA and (4) determine the association of CSA with patient outcomes after surgery.

Data Sources: The electronic databases MEDLINE, EMBASE, and PubMed were searched in March 2018 for relevant studies. The Methodological Index for Non-Randomized Studies (MINORS) appraisal tool was used to assess the quality of the included, nonrandomized studies. The results are presented in a narrative summary.

Main Results: A total of 26 studies and 4563 patients satisfied the inclusion criteria. The mean MINORS score for non-comparative and comparative studies was 12.0 ± 0.8 and 16.4 ± 1.6 respectively. The majority of CSAs were measured using radiographs (98.2%) in neutral rotation (72.9%). Significant associations ($P < 0.05$) were found between lower CSAs (<30 degrees) and osteoarthritis, and higher CSAs (>35 degrees) with primary rotator cuff tears and the risk of re-tear following a repair. The CSA has excellent intra-rater [intraclass correlation coefficient (ICC), 0.903-0.996] and inter-rater reliability (ICC, 0.869-0.980) when measured with radiographs. A high variability in measurements was found when using magnetic resonance imaging. The CSA however, is not a clear, independent predictor ($P > 0.05$) of outcomes after the management of shoulder pathologies.

Conclusions: The CSA is an effective radiographic parameter to predict the presence of rotator cuff tears and osteoarthritis. Lower CSAs (<30 degrees) are associated with osteoarthritis, whereas, higher CSAs (>35 degrees) are associated with primary rotator cuff tears and retear after arthroscopic repair. Currently, there is limited predictive value of the CSA in patient reported outcomes after rotator cuff repair. The CSA is measured with high intra- and inter-rater reliability for both radiographs and CT scans. Measuring the CSA using radiographs with the arm in neutral rotation is currently recommended. Future studies are required to further investigate how best use the CSA to guide patient management and its predictive value.

Intraoperative Radiation Exposure in Hip Arthroscopy: A Systematic Review

Ajay Shah, BSc,* Mohammed Nassri, MBBS,† Jeffrey Kay, MD,† Nicole Simunovic, MSc,† Vasco V. Mascarenhas, MD, MSc,‡ A. J. (Tony) Andrade, MSc, MBBS,§ Oliver R. Marin-Peña, MD,¶ and Olufemi R. Ayeni, MD, PhD,†,‖

*Affiliations: *Michael G. DeGroote School of Medicine, McMaster University, Hamilton, ON, Canada; †Division of Orthopaedic Surgery, Department of Surgery, McMaster University, Hamilton, ON, Canada; ‡Musculoskeletal Imaging Unit, Department of Radiology, Hospital da Luz, Lisbon, Portugal; §Reading Orthopaedic Centre, CircleReading Hospital, Reading, United Kingdom; ¶Orthopedic Surgery and Traumatology Department, University Hospital Infanta Leonor, Madrid, Spain; and ‖Department of Health Research Methods, Evidence, and Impact, McMaster University, Hamilton, ON, Canada.*

Objective: Fluoroscopy is used in hip arthroscopy (HA) for portal placement, instrument localization, and guidance in bony resection. The recent increase in arthroscopic hip procedures may place patients and surgeons at risk for increased radiation exposure and radiation-induced complications. The purpose of the current systematic review was to assess intraoperative radiation exposure in HA.

Data Sources: The systematic review was conducted according to PRISMA guidelines. The online databases Web of Science, EMBASE, and MEDLINE were systematically searched for literature addressing radiation exposure during HA.

Main Results: Nine studies including 994 patients were included. Mean age was 38.6 years and 48% (436 of 906) were female. Mean time of fluoroscopy exposure was 0.58 minutes. Dose area product was 129.5 $cGycm^2$. Mean intraoperative absorbed radiation dose studies was 12.6 mGy. Mean intraoperative effective dose was 0.48 mSv. The mean occupational exposure to the surgeon per case was 0.0031 mSv. Higher patient BMI correlated to greater patient effective and cumulative dose ($P < 0.05$, r = 0.404), and greater occupational exposure ($P < 0.001$, r = 0.460). Increasing surgeon experience decreased fluoroscopy time ($P = 0.039$) and radiation dose ($P = 0.002$). Radiation dose and effective dose were well under the thresholds for deterministic effects (2 Gy) and annual radiation exposure for occupational workers (20 mSv).

Conclusions: Intraoperative radiation exposure to patients and surgeons is within acceptable annual radiation limits. Ensuring careful selection of perioperative imaging modalities, proper protective shielding, specifically the use of leaded eyeglasses, and optimal C-arm positioning are key strategies to reduce radiation exposure to patients and surgeons alike.

Health-Related Quality of Life After Hip Arthroscopy for Femoroacetabular Impingement: A Systematic Review and Meta-Analysis

Chetan Gohal, MD,* Saif Shamshoon, BSc,† Muzammil Memon, MD,* Jeffrey Kay, MD,* Nicole Simunovic, MSc‡, Filippo Randelli, MD,§ and Olufemi R. Ayeni, MD, PhD*

*Affiliations: *Division of Orthopaedic Surgery, Department of Surgery, McMaster University, Hamilton, ON, Canada; †Michael G. DeGroote School of Medicine, McMaster University, Hamilton, ON, Canada; ‡Department of Methods, Evidence and Impact, McMaster University, Hamilton, ON, Canada; and §Dipartimento di Ortopedia e Traumatologia V, Istituto di Ricovero e Cura a Carattere Scientifico (IRCCS) Policlinico San Donato, Milan, Italy.*

Objective: Hip pain from femoroacetabular impingement (FAI) can impair health-related quality of life (HRQL) but can be treated via hip arthroscopy techniques. The objectives of this study were to systematically assess the health-related quality of life outcomes following arthroscopic management of FAI.

Data Sources: Three online databases (EMBASE, PubMed, and Ovid [MEDLINE]) were searched for relevant literature from database inception until June 2018, and screened by 2 reviewers independently and in duplicate. Level I to IV English studies that investigated HRQL outcomes after hip arthroscopy were included. Data for generic and hip-specific HRQL outcomes was collected. Mean differences were combined in a meta-analysis using a random effects model when possible.

Results: A total of 29 studies were included for assessment. Of the 6476 patients (6959 hips), the mean age was 32 years

(range, 9-79) and 50.7% were female. Significant improvements were reported in all studies assessing generic HRQL outcomes, including the Short Form-12 (SF-12) (range of mean postoperative scores, 82.0-89.8), and EuroQOL-5D (EQ-5D) scores (range of mean postoperative scores, 0.74-0.87). Significant improvements were similarly identified in the hip-specific HRQL outcomes scores, with the majority of studies reporting improvement at 12 to 24 months postoperatively. Mean improvement in International Hip Outcome Tool-33 (iHOT-33) scores from preoperative values to 12 to 24 months postoperative values was 34.1 (95% CI, 31.0-37.2; $P < 0.0001$; $I^2 = 44\%$).

Conclusions: Hip arthroscopy leads to significant improvement in generic and hip specific health-related quality of life outcomes at 12 to 24 months post-operatively in patients with FAI who do not have advanced hip osteoarthritis. Confirmatory, high quality, prospective studies are warranted to compare this observed improvement with other treatment modalities for FAI and to determine long-term outcomes.

Ultrasound-Guided, Minimally Invasive Thread Fasciotomy for Exertional Compartment Syndrome of the Lower Leg—A Cadaveric Study

Mark Sommerfeldt, MD, MPH, FRCSC, BScPT, Dip Sport Med,* Elizabeth Jack, MD,* Larry Playfair, MD, FRCSC,† Lalith Satkunam, MBBS, FRCPC,‡,§ Eldon Loh, MD, FRCPC,¶ Brian Rambaransingh, MD, FRCPC,‡ and Robert Burnham, MSC, MD, FRCPC, Dip Sport Med†,‡

*Affiliations: *Division of Orthopaedic Surgery, Department of Surgery, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada; †Central Alberta Pain and Rehabilitation Institute, Lacombe, AB, Canada; ‡Division of Physical Medicine and Rehabilitation, Department of Surgery, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada; §Division of Anatomy, Department of Surgery, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada; and ¶Department of Physical Medicine and Rehabilitation, Schulich School of Medicine and Dentistry, Western University, London, ON, Canada.*

Objective: Surgical fasciotomy is the standard for treating recalcitrant cases of chronic exertional compartment syndrome (CECS). Alternative, minimally-invasive techniques are emerging. Thread fasciotomy has been previously described as a feasible means of carpal tunnel release in an outpatient setting. This study describes and evaluates a novel technique of ultrasound-guided thread fasciotomy for release of anterior and lateral compartments of the leg in a cadaver model.

Study Design: Controlled laboratory study.

Subjects: Ten lightly embalmed cadaver leg specimens collected from 5 donors, 3 female and 2 male, aged 69 to 97 year old, with a mean Body Mass Index (BMI) of 22.4 kg/m^2.

Intervention Technique: Two proceduralists performed a total of 20 compartment releases using ultrasound-guided hydrodissection and percutaneous cutting thread technique. The specimens were then dissected by 2 additional investigators.

Outcome Measures: Fasciotomy length (cm), completeness of fasciotomy (% target length), and any inadvertent injury to muscle, tendon or neurovascular structures.

Results: Mean fasciotomy length was 17.4 cm (anterior compartment 19.0 cm, lateral compartment 15.9 cm).

Fasciotomy length was consistently under-target (72% complete), significantly more so for the lateral compartment than the anterior (65% vs 79%, $P = 0.014$). 18/20 (90%) of fasciotomies were continuous. 16/20 (80%) had no iatrogenic soft tissue injury.

Conclusions: Ultrasound-guided thread fasciotomy of the anterior and lateral leg compartments can be successfully performed in a cadaver model with low risk to neurovascular structures. However, further modification of the procedure is required to improve completeness of release before it could be recommended for clinical use.

Evaluating the Quality of Care for Patients With Chronic Rotator Cuff Tears

Breda H. F. Eubank, PhD, CAT(C),* Nicholas G. Mohtadi, MSc, MD,† Mark R. Lafave, PhD, CAT(C),* David M. Sheps, MSc, MBA, MD,‡ and J. Preston Wiley, MPE, MD†

*Affiliations: *Mount Royal University, Calgary, AB, Canada; †University of Calgary, Calgary, AB, Canada; and ‡University of Alberta, Edmonton, AB, Canada.*

Objective: To measure quality of care for patients with chronic rotator cuff tears in Alberta, Canada to identify areas for improvement.

Study Design: Descriptive survey research design.

Subjects: One hundred seventy-one patients presenting to 2 sport medicine centres in Calgary and Edmonton, Alberta were conveniently sampled.

Intervention: Patients were asked to complete 2 web-based questionnaires: the Healthcare Access and Patient Satisfaction Questionnaire and the Rotator Cuff Quality-of-Life Index. Both questionnaires were used to evaluate quality of care according to the 6 dimensions of quality defined by the Alberta Quality Matrix for Health.

Outcome Measures: Accessibility was measured using patient-reported waiting times. Acceptability was measured using patient satisfaction scores. Efficiency was measured by measuring healthcare consumption and calculating associated injury-specific costs. Effectiveness was measured using quality-of-life scores. Appropriateness was evaluated by comparing current to ideal clinical care pathways. And safety was evaluated by identifying unsafe practices or adverse events.

Results: The total mean waiting time for all patients from when the patient entered the healthcare system to appropriate treatment was 264 days (SD, 248; range, 14-1491), with patients waiting the longest to receive public magnetic resonance imaging (MRI) (103 days) and an orthopaedic surgeon consult (172 days). Patient satisfaction was lowest for emergency room physicians (58%; SD, 35%). The mean RC-QOL score for all patients was 42 (SD, 22). Twenty-two percent of patients experienced less than optimal care whereby care was fragmented, and MRI and physician services were over-utilized. Although no complications were reported, only 24% of patients received ideal standards of care within appropriate benchmark timeframes.

Conclusions: Much work is required to improve the level of care for patients with chronic rotator cuff tears in Alberta.

A Comparison of Outcomes Following Revision Versus Primary Anterior Cruciate Ligament Reconstruction in a Matched Cohort of Patients With 2 Year Follow-up

Jeremy Tynedal, MHE, Sarah Kerslake, MSc, Mark Heard, MD, Greg Buchko, MD, Laurie Hiemstra, MD, PhD, and Michaela Kopka, MD*

*Affiliation: *Banff Sport Medicine, Banff, AB, Canada.*

Objective: To compare clinical, functional, and patient-reported outcomes in matched cohorts of patients undergoing revision or primary anterior cruciate ligament reconstruction (ACL-R).

Study Design: Retrospective matched-cohort study.

Subjects: A total of 396 patients undergoing revision ACL-R were matched by sex, age, body mass index (BMI), and Beighton score to patients undergoing primary ACL-R.

Intervention: Revision versus primary ACL-R between January 2010 and August 2017 at a single institution by 1 of 4 fellowship-trained sport medicine surgeons

Outcome Measures: Intra-operative data including meniscal and chondral pathology was collected. Clinical and functional assessments were performed at 2 years follow-up. The ACL-Quality of Life Questionnaire (ACL-QOL) was completed pre-operatively and at final follow-up. Descriptive statistics and paired t-tests were used to compare outcome measures between groups. Limb symmetry indices (LSI) were calculated by comparing operative to non-operative limb performance. A one-way analysis of variance (ANOVA) was used to assess between-group differences in the ACL-QOL and post-operative graft laxity.

Results: Meniscal and chondral pathology was significantly more frequent in the revision ACL-R cohort (83.0% vs 68.2% and 57.5% vs 32.1%, respectively; $P < 0.05$). The mean graft diameter for all graft types was larger in the revision group compared with the primary group (8.55 $\pm$ 1.04 mm vs 7.64 $\pm$ 0.79 mm). At 2 year follow-up, the presence of a positive Lachman and positive Pivot Shift test was significantly more frequent in the revision group (21.5% vs 4.89%; $P < 0.05$). Graft failure was also higher in the revision compared with the primary group (10.3% vs 5.9%). No significant LSI differences were demonstrated between the revision and primary groups on any of the functional tests. No statistically significant differences were demonstrated in mean preoperative ACL-QOL scores. Mean ACL-QOL scores at 2 years were higher in the primary cohort and this was both statistically and clinically significant (76.0 $\pm$ 18.9 vs 61.3 $\pm$ 20.4; $P < 0.05$).

Conclusions: At 2 year follow-up, patients undergoing revision ACL-R demonstrated higher rates of meniscal and chondral pathology, increased graft laxity, and lower corresponding ACL-QOL scores compared to those undergoing primary ACL-R.

Adapted Home-Based Cardiac Rehabilitation Following a TIA or Minor Stroke? A Pilot Randomised Trial of "The Healthy Brain Rehabilitation Manual"

Neil Heron, PhD,*,†,‡ Frank Kee, MD,†,‡ Jonathan Mant, MD,§ Margaret E. Cupples, MD,*,†,‡ and Michael Donnelly, PhD†,‡

*Affiliations: *Department of General Practice and Primary Care, Queen's University, Belfast; †Centre for Public Health Research, Queen's University, Belfast; ‡UKCRC Centre of Excellence for Public Health Research (NI); and §Primary Care Unit, Department of Public Health and Primary Care, University of Cambridge, Strangeways Research Laboratory, Cambridge, United Kingdom.*

Objective: Secondary prevention, including positive lifestyle change and exercise/physical activity, after transient ischaemic attack (TIA) or minor stroke is important but the best way to effectively implement this is uncertain. Cardiac rehabilitation (CR) delivers effective secondary prevention for coronary heart disease but its value after a TIA or minor stroke is untested despite these conditions sharing similar pathology. We aimed to pilot a trial of a novel home-based prevention programme ("*The Healthy Brain Rehabilitation Manual*"), adapted from home-based CR, for patients with a TIA or "minor" stroke.

Design: Pilot randomised controlled trial.

Subjects: Patients within 4 weeks of their first TIA or "minor" stroke.

Intervention: Patients received study information from clinicians in 4 hospitals and were randomly allocated to: (1) standard care (control group) (n = 12); (2) standard care, manual and GP follow-up (n = 14); (3) standard care, manual and stroke nurse follow-up (n = 14). All participants received telephone follow-up at 1, 4 and 9 weeks. The manual included information about TIA/stroke, discussed a different lifestyle risk factor each week for 6 successive weeks and promoted physical activity, using pedometer step-count targets.

Outcome Measures: We assessed eligibility, recruitment and retention rates; measured stroke/cardiovascular risk factors, including body mass index (BMI), blood pressure, physical activity (questionnaire; accelerometer), diet (validated questionnaire) and functional measures (2-minute walk test; Timed-Up-and-Go test) at baseline and 12 weeks post-enrollment; and elicited participants' views about the study via focus groups.

Results: Over a 32-week period, 28% of clinic attendees (125/443) were eligible; 35% (44/125) consented to research contact; 91% (40/44) participated: 98% (39/40) completed the study. At baseline most participants were overweight, physically inactive and had unhealthy diets. After 12 weeks, intervention groups' BMI, diet, physical activity (questionnaire and objective measures) and functional performance improved. The research methods and programme were acceptable to patients and health professionals; the programme was perceived to "fill gaps" in current post-TIA management.

Conclusions: Our findings indicate that implementation of this novel home-based CR programme, and of a trial to evaluate its effectiveness, is feasible, with potential for clinically important benefits, increasing physical activity and improving secondary prevention following a TIA or "minor" stroke.

Anterior Cruciate Ligament Reconstruction With or Without A Lateral Extra-Articular Tenodesis—Functional Outcomes From the STABILITY Study

R. McCormack,*,† D. Boyer,* A. Getgood,‡,§ C. Hewison,‡ A. Firth,‡ D. Bryant,‡,¶ R. Litchfield,‡,§ M. Heard,∥,** and P. MacDonald,††,‡‡ STABILITY Study Group

Affiliations: *Department of Orthopedics, University of British Columbia; †New West Orthopaedic & Sports Medicine Centre; ‡Fowler Kennedy Sport Medicine Clinic; §Department of Surgery, Schulich School of Medicine and Dentistry, Western University; ¶School of Physical Therapy, Western University; ‖Deparment of Surgery, University of Calgary; **Banff Sport Medicine; ††Department of Surgery, University of Manitoba; and ‡‡Pan Am Clinic.

Objective: To investigate the effect of a lateral extra-articular tenodesis (LET) on functional indices post ACL Reconstruction (ACLR).

Design: Multicenter, randomized clinical trial.

Intervention: Six hundred twenty-four patients under the age of 25 years were randomized to either ACLR alone or ACLR with LET then followed for 2 years postoperatively.

Outcome Measures: The primary outcome was Limb Symmetry Index (LSI) calculated using a series of 4 hop tests. Secondary outcome measures included quadriceps index (QI) and hamstrings index (HTI) measured using an isokinetic dynamometer and Lower Extremity Functional Scale (LEFS).

Results: At 6 months, the ACLR alone group had an LSI of 94% and the ACLR/LET group had an LSI of 91% ($P = 0.01$). At 12 months, the ACLR group had an LSI of 96% and the ACLR/LET group had an LSI of 95% ($P = 0.33$). Isokinetic strength testing was completed at 6, 12 and 24 months. At 6 months, the ACLR group had a QI peak torque of 79% and an average power of 81%. The ACLR/LET group had a QI peak torque of 74% ($P = 0.04$) and an average power of 76% ($P = 0.01$). At 12 months, the ACLR group had a QI peak torque of 90% and an average power of 90%. The ACLR/LET group had a QI peak torque of 87% ($P = 0.12$) and an average power QI of 87% ($P = 0.32$). At 6 months, the ACLR group had a LEFS score of 70 and the ACLR/LET group had a LEFS score of 68 ($P = 0.03$). At 12 months, the ACLR group had a LEFS score of 72 and the ACLR/LET group had a LEFS score of 73 ($P = 0.24$). No significant differences existed between the 2 groups at 12 or 24 months for HTI.

Conclusions: At 6 months postoperative, we found significant differences, in favor of ACLR alone, for hop test limb symmetry index, peak torque, average power quadriceps index, and a subjective functional score. All outcomes were no longer statistically different by 12 months postoperative. The addition of LET may mean a slower rate of recovery with no differences from 12 months onward.

No Change in Cardiovascular Fitness of Recreational Athletes From Injury to 12-Months Post Anterior Cruciate Ligament Reconstruction

Dean M. Cordingley, MSc,* Sheila McRae, PhD,* Jeff Leiter, PhD,*,† Greg Stranges, MD,*,† and Peter MacDonald, MD*,†

Affiliations:*Pan Am Clinic Foundation, Winnipeg, MB, Canada; and †Section of Orthopedic Surgery, Max Rady College of Medicine, University of Manitoba, Winnipeg, MB, Canada.

Objective: To evaluate changes in cardiovascular fitness in recreational athletes from injury to 12-months post-anterior cruciate ligament reconstruction (ACLR).

Study Design: Prospective longitudinal case series.

Subjects: Recreationally active subjects with a complete ACL rupture.

Observation Technique: Subjects performed a graded aerobic fitness test as soon after injury as possible (T1) and then 6 (T2) and 12-months (T3) following ACLR.

Outcome Measures: The primary outcome measure was relative peak oxygen consumption ($\dot{V}O_{2\ Peak}$). Secondary outcome measures were absolute $\dot{V}O_{2Peak}$, peak heart rate (HR), Tegner activity score and ACL-Quality of Life (QOL).

Results: Six females (age, 23.3 ± 5.5 years; height, 1.73 ± 0.04 m; body mass, 67.6 ± 9.4 kg) and 13 males (age 22.8 ± 4.7 years; height, 1.79 ± 0.07 m; body mass, 84.8 ± 13.2 kg) participated in the study. The first testing was performed 78 ± 48 days post injury, and surgery was performed 152 ± 81 days post-injury. No changes were detected in relative $\dot{V}O_{2Peak}$ (T1, 33.7 ± 6.3 mL·kg^{-1}·min^{-1}; T2, 32.7 ± 8.9 mL·kg^{-1}·min^{-1}; T3, 32.7 ± 9.3 mL·kg^{-1}·min^{-1}; $P = 0.89$), absolute $\dot{V}O_{2Peak}$ (T1, 2.62 ± 0.63 L·min^{-1}; T2, 2.53 ± 0.62 L·min^{-1}; T3, 2.68 ± 0.76 L·min^{-1}), and peak HR (T1, 181.5 ± 15.0 bpm; T2, 183.8 ± 9.2 bpm; T3, 179.1 ± 12.5 bpm). Based on the Cooper Institute for Aerobics Research cardiorespiratory fitness classifications, 14/19 participants were determined to be in the poor category at T1 and 12/19 at T3. The distribution of relative $\dot{V}O_{2Peak}$ measurements did not change from T1 to T3 ($P = 0.88$). Tegner scores improved following surgery but did not reach pre-injury levels by the 12-month mark (Pre-injury, 7.9 ± 1.3; T1, 3.5 ± 1.9; T2, 4.4 ± 1.4; T3, 5.5 ± 2.0; $P < 0.001$). ACL-QOL improved incrementally over time (T1, 32.9 ± 15.5; T2, 53.5 ± 13.4; T3, 70.3 ± 18.7; $P < 0.001$).

Conclusions: No difference from post ACL rupture to 12-months post ACL reconstruction was observed in recreational athletes. Aerobic conditioning should be included in ACLR rehabilitation to ensure the athletes do not return to play with potentially increased risk of injury associated with cardiovascular fatigue.

Cross-Sectional Study of the Physical Activity Levels of the Patients Within One of the Largest Academic Urban Family Health Teams in Canada

Alessandro Francella, MD,* Lee Mark Schofield, MD,† Alexandra Wudwud, MSc,‡ Patrick Frost, BSc,§ and Charlie Guiang, MD¶

Affiliation: University of Toronto, St. Michael's Hospital Academic Family Health Team (SMHAFHT), Toronto, ON, Canada.

Objective: To determine the prevalence of patients in a large, urban, academic family health team who meet the Canadian Physical Activity Guidelines of 150 minutes per week of moderate-to-vigorous physical activity (PA).

Study Design: Cross-sectional.

Subjects: Two hundred questionnaires were collected from patients rostered to 6 family medicine clinics within the SMHAFHT. The final data analysis included 187 (51.3% female, 43.9% male) participants.

Intervention: A self-reported questionnaire containing the International Physical Activity Questionnaire (IPAQ) and demographic information was provided to eligible patients at each clinic. Data was collected from November 2017 to February 2018.

Outcome Measures: Questionnaires were scored using established methods from the IPAQ website (www.ipaq.ki.se) and summarized to report PA levels in high-, moderate-, and low-active groups. The duration of vigorous, moderate, and walking activity was weighted based on the energy expended at each intensity level to produce MET-minutes of PA. A demographic section contained the following non-identifying information: age, gender, clinic, education level, employment,

poverty screen, self-perceived health status, co-morbidities, and interest in learning the benefits of PA.

Results: 49.2% reported a moderate activity level, 38.5% a high activity level and 12.3% a low activity level. 69.5% viewed their health as "Good" or "Very Good." 32.1% indicated trouble making ends meet, double the Canadian average of people living in poverty (14%). 53.5% responded "No" to being interested in learning the benefits of PA. There was no statistical significance between poverty or responding "No" and PA levels. Chi-squared analysis revealed a statistically significant inverse relationship to diabetes ($P = 0.049$) and arthritis ($P = 0.045$), and a direct relationship to health status ($P = 0.027$).

Conclusions: This explorative and cross-sectional study of PA levels of patients within an academic urban family health team revealed 87.7% of patients reported achieving moderate to high PA levels. A 2018 study of 6 low- and middle-income countries reported a prevalence of high sedentary behaviour (>8 h/d) as 8.3%, whereas our study group had a low-activity prevalence of 12.3%. There were statistically significant associations between PA levels and diabetes, arthritis, and health status. These conditions would benefit most from PA intervention at this time.

Exploring Successful Return-to-School for Canadian Youth Following a Concussion

D. Greenspoon,* A. Karim, C. Provvidenza,* P. King-Taylor, J. Carson,† B. Csenge, L. Schultz,‡ and N. Reed*,§

*Affiliations: *Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada; †Department of Family and Community Medicine, University of Toronto, Toronto, ON, Canada; ‡Faculty of Medicine, University of Calgary, Calgary, AB, Canada; and §Department of Occupational Science and Occupational Therapy, University of Toronto, Toronto, ON, Canada.*

Objective: To generate recommendations for how to optimally involve all stakeholders in a student's return-to-school after a concussion and to increase the transportability of the Green Folder return-to-school protocol and enable its use with other schools and boards across Canada.

Study Design: Qualitative research using semi-structured interviews. All interviews were audio recorded and transcribed. The transcriptions were then analyzed, coded, and examined for common themes by 2 independent reviewers.

Subjects: The study took place at a secondary school in Ontario, Canada, and included the following stakeholders: 10 teachers, one member of the administration, 5 students, 4 parents, and 4 health professionals including Family Physicians.

Intervention: The school utilizes the school board's established return-to-school concussion protocol in combination with a self-developed Green Folder of documents to inform and guide student progression, accommodations, and collaborative communication to support students' return-to-school post-concussion.

Outcome Measures: Themes elicited from stakeholder participant interviews related to barriers or facilitators for a student's return-to-school after a concussion using the school board's return-to-school protocol and the school's Green Folder.

Results: Twelve over-arching themes emerged from the semi-structured interviews. These themes include:

introduction of the Green Folder process, the student concussion experience, concussion management experience prior to the implementation of the Green Folder process, implementation of the Green Folder process, elements of the Green Folder that facilitated the recovery process, impact of the Green Folder on the student's recovery, satisfaction with the Green Folder process, challenges and recommendations, key learnings, leadership support, value of the Green Folder, and recommendations to improve feasibility and accessible implementation board-wide.

Conclusions: The recommendations of school staff, students, parents and health professionals who have participated in the use of the school board's return-to-school protocol and the school's Green Folder implementation process illustrate an approach to optimize the return-to-school implementation process and increase the transportability of the protocol outside of the school board and enable its use with other schools, school boards, and health professionals across Canada. This study facilitated the creation of the evidence-informed Holland Bloorview SCHOOLFirst resource.

Online Sport and Exercise Medicine Curriculum With Learning Modules

Alessandro Francella, MD,* Neil Dilworth, MB BCh BAO,* Youssef Hegazy,† Kevin Asem, MD,‡ Alyssa Cantarutti, MD,§ Howard Chen, MD,* Ivy Cheng MD,* Wes Clayden, MD,§ Ryan Eardley, MD,* Leah Hillier, MD,* Sari Kraft, MD,* David Lawrence, MD,* Mark Leung, MD,* Kristopher Lundine, MD,¶ Duong Nguyen, MD,∥ Lucas Nguyen, HBSc,* Tomas O'Neill RCSI,** and Tim Rindlis-bacher, MD*

*Affiliations: *University of Toronto, Toronto, ON, Canada; †York University, Toronto, ON, Canada; ‡Western University, London, ON, Canada; §University of British Columbia, Vancouver, BC, Canada; ¶University of Melbourne, Melbourne, Australia; ∥McMaster University, Hamilton, ON, Canada; and **MacQuarie University, Sydney, Australia.*

Objective: To provide medical students, residents of family medicine, sport and exercise medicine, emergency medicine, orthopedics, physiatry, and rheumatology with an online sport and exercise medicine curriculum with learning modules that provides the background knowledge required to assess and treat sport and exercise medicine conditions.

Study Design: Educational.

Methods: A combination of 15 practicing sport and exercise medicine and other specialists from 2 different countries recorded video lectures on 20 different sport and exercise medicine related topics. Topics were released on a weekly basis to sport and exercise medicine residents via email and posted on www.sportsmedschool.com. Each topic has a learning module containing a series of post-test questions to be answered at the completion of the lectures.

Results: In September 2018, the first week of lectures were sent out to 4 sport and exercise medicine program directors in Ontario, Canada. Lectures have subsequently been released at weekly intervals. The topics are divided into anatomical and topical conditions. The anatomical conditions include: head/neck, concussion, cervical spine injuries, shoulder, elbow, wrist, hand, thoracolumbar pine, hip/groin, knee, ankle, foot. The topical conditions include: emergencies in sport and exercise medicine, altitude medicine, relative energy deficiency

in sport, paediatric sport and exercise medicine, event coverage, stress fractures, dermatological conditions in sport, and para-athletic conditions in sport.

Conclusions: The collaboration of sport and exercise medicine physicians has allowed for the development of an online sport and exercise medicine curriculum to assist trainees in improving their knowledge through a set of weekly video lectures. It is our plan to continue to expand on this lecture series to further increase knowledge in sport and exercise medicine.

Telomere Length Is Not Influenced by Age, Sex or History of Sport-Related Concussion in Varsity and Community Athletes

Matthew Machan, BHSc,* Regan King, MSc,* Richelle Mychasiuk, PhD,† Bonnie Sutter, AT,‡ Preston Wiley, MPE, MD,‡ and Chantel T. Debert, MD, MSc*,‡,§

*Affiliations: *Department of Clinical Neurosciences, University of Calgary, Calgary, AB, Canada; †Department of Neurosciences, Monash University, Melbourne, Australia; and ‡University of Calgary Faculty of Kinesiology, Calgary, AB, Canada; and §University of Calgary Hotchkiss Brain Institute, Calgary, AB, Canada.*

Objective: Telomere length (TL) plays an active role in epigenetic patterning and cellular growth and recovery. Animal studies have shown TL to be significantly shorter following concussion and is positively correlated with symptom severity. We aimed to determine whether sex, age and previous concussion history significantly influenced TL in varsity and community athletes. This will illustrate TL viability as a prognostic and diagnostic fluid biomarker of sport-related concussion (SRC).

Study Design: Observational cross-sectional cohort study.

Subjects: One hundred thirty-five varsity athletes attending the University of Calgary, and community athletes [80 males and 55 females (mean ± SD = 19.43 ± 1.97 years)] playing rugby, football, soccer, field-hockey, lacrosse, and ice-hockey.

Intervention: Collection of patient demographics, medications, concussion history and morning saliva.

Outcome Measures: Saliva samples were collected between 6:00 and 10:00 AM using a clean drool technique. TL was measured using the telomere to single copy ratio, corresponding to the 36B4 gene. The resulting ratio is used to calculate relative subject TL (in base pairs). Logistical regression and adjusted odds ratio with 95% confidence intervals were performed to examine the relationship between TL and concussion history controlling for age and sex.

Results: Athlete ages ranged from 15 to 27 (19.43 ± 1.97) and 60% were males. The number of previous concussions included 0 (n = 68), 1 (n = 46), 2 (n = 13), or ≥3 (n = 8) (mean = 0.74 ± 0.98). There was no association between previous concussion history and TL [5547.12 ± 336.93, adjusted odds ratio (95% CI) 1.00 (0.99-1.00); $P = 0.82$], nor was there a dose response due to the number of previous concussions ($P = 0.192$). Further, the model was not influenced by age [0.89 (0.74-1.07); $P = 0.21$] or gender [0.62 (0.31-1.25); $P = 0.18$].

Conclusions: Pre-injury saliva TL was not influenced by a past medical history of concussion, age, or sex in the given age range of athletes. The stability of fluid biomarker TL suggests that post-acute SRC TL assessments may aid in diagnosis, prognosis, and recovery. Future direction includes comparing pre-and post-SRC TL to predict symptom burden and recovery duration.

Changes in Symptoms and Binocular Vision Tests With Concussion

I. Shrier,* S. Leclerc,† and G. Zhong‡

*Affiliations: *Centre for Clinical Epidemiology, Lady Davis Institute, Jewish General Hospital, McGill University; †Institut National du Sport du Quebec, Montreal, QC, Canada; and ‡Consultant, Montreal, QC, Canada.*

Purpose: Binocular vision tests (BVTs) are increasingly recommended for use in concussion management. Our objective was to determine the correlation between concussion-induced change in BVTs and concussion-induced change in symptoms.

Methods: We used routinely collected data on athletes who had tests for binocular vision and saccades pre-season, soon after concussion, and symptoms recorded at the time of testing. A specialist in the vision tests identified an a priori list of symptoms that might be expected to change based on changes in vision test scores. The tests assessed near point of convergence [NPC], near point of convergence—break [that is double vision, (NPCb)], ability of eyes to move/fixate in-sync (positive and negative fusional vergence at 30 cm and 3 m) and saccadic motion. We arbitrarily considered important changes to be ≥20% worsening of scores with concussion, and correlations >0.4.

Results: There were 7 males and 14 females with a mean age of 23.7 (SD, 4.5) years at baseline testing. The mean delay between baseline and concussion testing was 183 (range, 53-494) days, and the vision testing occurred 16 (range, 2-48) days after concussion. Test scores had important worsening (≥20%) following a concussion for NPC (34.5%, $P = 0.02$), NPCb (35.1%, $P < 0.01$), positive fusional vergence at 3 m (27.3%, $P = 0.18$) and 30 cm (27.7%, $P = 0.10$). Test scores had no important change (<20% difference) for saccade (6.0%), or negative fusional vergence at 3 m (14.8%, $P = 0.02$) or 30 cm (15.2%, $P = 0.02$). Although correlations between worsening in symptoms and worsening in test scores were very low for (range, 0.01-0.15) for 5/6 tests, the correlation coefficient for worsening of symptoms and negative fusional vergence was 0.62 ($P = 0.04$). The slopes for NPC and NPCb were 0.77 ($P = 0.08$) and 0.66 ($P = 0.22$) respectively.

Conclusions: Worsening of some binocular vision tests occurred with concussion but the differences were modest compared to previous reliability studies. In this small sample of participants, there were only small correlations between worsening of symptoms and worsening of the vision tests but larger sample sizes are required for more definitive conclusions.

Translation and Cross-Cultural Adaptation of the English Version of the Knee Self-Efficacy Scale

A. M. Ezzat,*,† J. L. Whittaker,‡,§,¶ M. Brussoni,*,†,‖,** L. Masse,*,† and C. A. Emery§,¶

Affiliations: *School of Population and Public Health, University of British Columbia, Vancouver, BC, Canada; †British Columbia Children's Hospital Research Institute, Vancouver, BC, Canada; ‡Department of Physical Therapy, Faculty of Rehabilitation Medicine, Glen Sather Sports Medicine Clinic, University of Alberta, Edmonton, AB, Canada; §Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; ¶The Alberta Children's Hospital Research Institute and McCaig Institute for Bone and Joint Health, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; ‖Department of Pediatrics, University of British Columbia, Vancouver, BC Canada; and **BC Injury Research and Prevention Unit, Vancouver, BC, Canada.*

Objective: To translate and cross-culturally adapt the Knee Self-Efficacy Scale (K-SES) into English and evaluate the psychometric properties of the scale.

Study design: Psychometric evaluation.

Subjects: Participants included individuals (n = 125) aged 16 to 60 years, with a medical attention (consulted a physician or physiotherapist), time loss (minimum 6 weeks participation) sport-related intra-articular tibiofemoral or patellofemoral injury within the last 5 years. Participants were recruited from 3 locations: Glen Sather Sports Medicine Clinic, University of Alberta, Edmonton, Alberta; Fortius Sport and Health, Burnaby, British Columbia (BC); and North Shore Sports Medicine, North Vancouver, BC.

Observation Technique: Translation and cross-cultural adaptation followed a standardized multi-step process guided by Consensus-based Standards for the selection of health Measurement INstruments (COSMIN) guidelines. Study participants completed the K-SES and other knee-specific questionnaires online [Knee Injury and Osteoarthritis Outcome Score (KOOS), Anterior cruciate Ligament-Return to Sport After Injury Scale (ACL-RSI), Tegner Activity Level Scale, and Multi-dimensional Health Locus of Control (MHLC) Form C] to evaluate components of validity. A subgroup of participants (n = 42) completed the K-SES twice to assess intra-rater reliability.

Outcome Measures: The K-SES consisted of 2 subscales: present and future knee self-efficacy. Confirmatory factor analysis (CFA) tested a-priori 2 factor structure and model fit. Internal consistency was assessed with the Cronbach-alpha, intra-class correlation coefficient (ICC) tested intra-rater reliability, and Bland Altman plot evaluated absolute reliability. Construct validity was assessed by 8 pre-defined hypotheses.

Results: The cross-cultural adaptation generated an English K-SES with face and content validity. However, the original two-factor structure was rejected based on CFA. A revised solution informed by Exploratory Factor analysis and assessed with CFA resulted in an adequate fit [X2 (df = 130), 435.46, P = 0.001, RMSEA = 0.11 95% CI (0.09-0.12), CFI = 0.90]. All construct validity hypotheses were confirmed. The K-SES showed good internal consistency (F1: alpha = 0.96; F2: alpha = 0.73), good intra-rater reliability (ICC = 0.92), and no systematic bias between measurements by Bland-Atman plot. All construct validity hypotheses were confirmed.

Conclusions: The English K-SES is a valid and reliable measure for knee-specific self-efficacy in individuals who have sustained a sport-related intra-articular knee injury in the previous 5 years.

Cognitive Performance in Varsity Athletes With Persistent Concussion Symptoms

Vicki Wong, PT, PhD Candidate,* Kaylyn Dixon, MSc,* Taryn Taylor, MD, MSc,† Laura Stokes, BSc,* and Matthew Holahan, PhD*

Affiliations: *Carleton University, Ottawa, ON, Canada; and †Carleton Sport Medicine Clinic, Ottawa, ON, Canada.*

Objective: To determine whether persistent concussion symptoms impact cognitive performance.

Study Design: Repeated measures, clinical trial.

Subjects: Two Hundred and twelve varsity athletes (124 females and 84 males) completed the baseline testing. Over 2 years, 15 athletes with concussion were reassessed.

Intervention/Observation Techniques: Subjects completed a baseline series of questionnaires and computer-based cognitive tests. These were repeated at 2 weeks and 3 months post-concussion. Subjects were divided into 3 groups: (1) control; (2) had a previous concussion prior to the study period; and (3) concussed during the study period.

Outcome Measures: The outcome measures were based on the following questionnaires: Rivermead Post-Concussion Symptoms (Rivermead), Beck Depression Inventory (BDI), Cognitive Flexibility Questionnaire (CFQ), and the Survey of Coping Profile Endorsement (SCOPE). The computer-based outcome measures included the Wisconsin Card Sorting Task (WCST), the Go No Go task (GNG), and the Iowa Gambling Task (IGT). Analyses were carried out across the 3 time periods and between the 3 groups of athletes.

Results: There was no difference in the 95% CI in the BDI, Rivermead, SCOPE, or the IGT. There were significant decreases in the cognitive resources' subset for the CFQ between the previous concussed group and the in-season concussed group at 3 months ($P < 0.03$). Significant decreases in the total errors ($P < 0.02$) and preservative errors ($P < 0.04$) from baseline to 3 months for the in-season concussed group were also found. GNG revealed decreased total correct ($P < 0.03$) and increased total errors ($P < 0.03$) for the in-season concussed group compared to the previously concussed group.

Conclusions: Persistent symptoms of concussion can negatively impact cognitive performance and coping in varsity athletes. The CFQ demonstrates decreased ability to recruit different coping strategies in those after concussion the lack of impulse control in the GNG is present at 3 months post-concussion and shows that the athlete makes more errors and less correct choices that could impact the playing of their sport. These cognitive measures are not often assessed in return-to-play protocols but indicate that impairments may still exist by 3 months post-concussion.

Adapted Sport and Recreation Summer Camp; Perspectives of Youth Regarding Impact on Psychosocial Outcomes and Physical Activity Participation

Elysa Sandron, BSc,*,† Meghan McDonough PhD,* Elizabeth G. Condliffe, MD, PhD,†,‡ Laura Brunton, PT, PhD,§ David Legg, PhD,¶ and Carolyn Emery, PT, PhD*,†

Affiliations: *Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Vi Riddell Pediatric Rehabilitation Research Program, Alberta Children's Hospital Research Institute, Cumming School of Medicine, Calgary, AB,*

Canada; ‡Department of Clinical Neurosciences, Alberta Children's Hospital; §School of Physical Therapy, Western University, London, ON, Canada; and ¶Health and Physical Education, Mount Royal University, Calgary, AB, Canada.

Objective: (1) To examine how an adapted sport and recreation (S&R) camp may facilitate a pathway to regular participation in physical activity (PA). (2) To assess the psychosocial benefits of an adapted S&R program from the perspective of youth with physical disabilities.

Study Design: Case series.

Participants: Youth (n = 24) aged 12 to 18 with physical disabilities who participated in a 1 week adapted S&R summer camp at the University of Calgary.

Intervention/Observation Technique: The adapted S&R camp provided youth an opportunity to experience adapted S&R activities offered in the community (eg, sledge hockey, wheelchair rugby, rock climbing). Participants completed a photo-elicitation exercise and a semi-structured interview about their experiences with the camp, the psychosocial benefits, and how they thought the camp could facilitate PA. Interviews were transcribed and thematically analysed.

Results: Five themes were identified. Youth found comfort amongst those with disabilities in the context of the camp. The youth reported improved communication skills with their peers and ability to express their needs. Participation in a program designed to introduce adapted S&R activities allowed youth to reframe their view of therapeutic exercises as sport and devices as sports equipment. The camp empowered youth by allowing them discover their own abilities. Adapted S&R programming is an outlet for youth to overcome stigma, as it provides a sense of belonging and increases confidence.

Conclusions: Findings suggest adapted S&R camps are a possible pathway supporting PA participation for youth with physical disabilities. Social experiences of acceptance and improved communication, together with opportunities to reframe disability in the context of S&R and to overcome stigma could facilitate motivation to participate in PA. A better understanding of these processes could help design programs that will facilitate regular participation for youth in S&R.

Sport Medicine Professionals: Gatekeepers to Para Sport and Physical Activity

Nancy Quinn, PhD(c), Dip. Sport Physiotherapy and Laura Misener

Affiliation: Western University, Graduate School of Kinesiology, London, ON, Canada.

Objective: To consider how para sport athletes become engaged with physical activity and sport and assess the athlete experience during medical encounters.

Study Design: Ethnographic interviews with para sport athletes during Commonwealth Games XII.

Literature: According to the Policy on Sport for Persons with a Disability (2006) 5 million Canadians live with impairment. Only 1% of this population are consistently engaged with sport and/or physical activity. Williams et al (2018) illustrated that physiotherapists and other health care professionals are ideally located, as valued and trusted messengers, to introduce people with impairment to sport and physical activity.

Results: Analysis of the data indicated 3 broad themes; (1) satisfaction with sport medicine care during competition; (2) evidence of strong therapeutic relationship with family physicians and rehabilitation therapists; and (3) positive impact of introduction of sport and leisure opportunities by health care providers.

"My family doctor directed me towards sport by showing video of para sport to me. He has now become my friend (Paralympian/athletics)"

Conclusions: Critical to the research was the identification of gatekeepers to sport and physical activity for people with impairment. By foregrounding the experience of the para sport athlete, health care professionals were identified as important and influential points of contact regarding initial involvement. Analysis also determined under-involvement of health care professionals in this role.

"I think we really have to go to the children's hospitals and rehab centers and really target them…doctors, nurses, therapists (retired Paralympian)"

As trusted and valued messengers of health-related information, health care professionals are uniquely located to introduce the benefits of sport and physical activity to the population of Canadians with impairment. Further research is needed to examine what tools are needed by health care professionals to embrace the role of gatekeeper to para sport and physical activity in the clinical setting. Development of a short video or phone application is an intended research output from this project.

Exploring the Value of the Return-to-School Resource "SCHOOLFirst": Evaluating Usability and Satisfaction

C. Provvidenza,* D. Greenspoon,* A. Cogliano,* J. Carson,† B. Csenge, P. King-Taylor, and N. Reed*

*Affiliations: *Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada; and †Department of Family and Community Medicine, University of Toronto, Toronto, ON, Canada.*

Objective: (1) Co-create an evidence-based resource to enable educators to support students with their return-to-school post-concussion; (2) Evaluate perceptions of education personnel on the usability of and satisfaction with the SCHOOLFirst resource; and (3) Understand the role of the SCHOOLFirst resource in supporting the return-to-school process.

Study Design: A cross-sectional survey design.

Subjects: Fifty-four education personnel (36 teachers, 6 school administrators, 12 "other") from a school board in Ontario, Canada.

Intervention/Observation Technique: SCHOOLFirst was created to support education personnel with "how" to return youth to school post-concussion; a gap that is not currently

addressed by existing protocols and resources. Guided by knowledge translation principles and best evidence, SCHOOLFirst was co-created by stakeholders with expertise in return-to-school processes for students post-concussion. Fifty-four education personnel participated in a training workshop where they received concussion education, were introduced to SCHOOLFirst in a pilot format, and learned how to access and use the resource. Feedback was gathered from the participants post-workshop via survey, which was used to inform and finalize SCHOOLFirst.

Outcome Measures: All data was collected using a hard copy survey following the training workshop. The survey consisted of a demographic form, the System Usability Scale, and a satisfaction questionnaire. Demographic and likert scale data was analyzed using descriptive statistics (frequency distributions) and thematic analysis was used for open-ended questions.

Results: Participants reported SCHOOLFirst to be easy to use (69.6%), not complex (62.5%), and felt confident using this resource (83.9%). Participants identified they were satisfied with (73.2%) and would use SCHOOLFirst in the future (83.9%). Some reported that SCHOOLFirst was overwhelming and would benefit from a summarized version as a quick reference guide. Overall, participants found the links, videos and potential classroom accommodations within SCHOOLFirst to be helpful.

Conclusions: This work emphasizes the importance of a collaborative approach in supporting the return-to-school process. It highlights the value of engaging multiple stakeholders to co-create concussion resources that meet the needs of targeted audiences. This research contributes to efforts to improve students' successful return-to-school post-concussion and emphasizes that everyone involved in a student's life has an important role to play in improving post-concussion outcomes.

Short Track Versus Hockey Helmets: Investigating Impact Attenuation Properties of Helmets in 2 Skating Sports

D. I. Aponte, MSc,* S. Leclerc, MD, PhD,† and D. J. Pearsall, PhD*

*Affiliations: *Kinesiology and Physical Education, McGill University; and †Institut National du Sport du Québec.*

Objective: To compare the impact attenuation characteristics between Short Track Speed Skating (ST) helmets and Ice Hockey (IH) helmets, in both high and low velocity impacts.

Study Design: Two-group experimental design.

Subjects: Five different helmet models; 3 ST models (27 helmets) and 2 IH models (8 helmets).

Observation Technique: Helmets were impacted at 2 impact velocities (high and low; 4.5 and 2.4 m/s respectively) and at 4 impact locations (rear, rear boss, side and front boss). This was performed using a linear impactor device and the Hybrid III surrogate headform and neck. In total, 276 impacts were performed and analyzed.

Outcome Measures: The outcome measurements were peak resultant linear acceleration and peak resultant rotational acceleration for every impact. One-way ANOVAs were performed for all impact conditions across groups and helmet models, as well as *Post hoc* and tests of effect size.

Results: There were statistically significant differences between helmet groups and models for all impact conditions.

Partial Eta-squared effect size values indicated a large effect for all conditions ($\eta^2 > 0.26$). The results point to a hierarchy of impact attenuation performance which takes the form of:

IH 2 > IH 1 > SS 3 > SS 1 > SS 2

With the IH 2 helmet performing the best, and all subsequent helmets performing progressively worse.

Conclusions: Results suggest that this group of IH helmets are better at attenuating both impact velocities than this group of ST helmets. Interestingly, the largest effect sizes were observed in the low-velocity impacts; IH helmets are required to pass low-velocity/low-energy impacts to be certified for sale, whereas ST helmets only undergo high velocity impacts during certification. These results suggest that certification standards may drive the R&D undertaken by manufacturers; as standards become more stringent, manufacturers must develop solutions to manage increased requirements.

Validation of a Field Test of Exertion in Adolescents

Lauren N. Miutz, EP-C, MS,*,† Carolyn A. Emery, PT, PhD,*,†,‡ Amanda M. Black, CAT(C), PhD,*,†,‡ Matt J. Jordan, PhD,*,† and Kathryn J. Schneider, PT, PhD*,†,‡,§,¶

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada; ‡Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada; §Acute Sport Concussion Clinic, Sport Medicine Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; and ¶Evidence Sport and Spinal Therapy, Calgary, AB, Canada.*

Objective: (1) Evaluate the feasibility of a field test of aerobic capacity (modified shuttle run test—mSRT), (2) examine the intra-rater reliability of the mSRT, and (3) evaluate the concurrent validity of a mSRT compared to the Buffalo concussion treadmill test (BCTT) in uninjured high school students.

Study Design: Validation study in which intra-rater reliability is also examined.

Subjects: Male students [n = 32; ages 15 (21.87%) and 16 (78.13%)] enrolled in high school sports performance courses in Calgary, Alberta.

Observational Technique: Students completed the mSRT twice (week 1 and 2) and the BCTT once (week 3). Heart rate (HR) utilizing a Polar HR monitor, self-reported rating of perceived exertion (RPE), and overall symptoms were assessed.

Outcome Measures: Peak HR (HR_{peak}) was measured prior to termination of each test. Test termination was defined as voluntary exhaustion or symptom threshold, an increase in symptoms ≥2. Pre-and post-exertion testing RPE and overall condition (Likert scale 0-10/10) were also obtained throughout the tests. Spearman's Rho was used to evaluate the correlation between HR_{peak} on: (1) repeat mSRT tests; and (2) between the first mSRT and BCTT.

Results: The mSRT was feasible in high school students, with all participating students completing the test and no reports of adverse events. Five of the 32 participants were omitted in the analysis due to missing exertional data as a result of absences throughout the school day. A positive correlation between the 2 mSRT tests was found for HR_{peak} ($r_s = 0.63$, $P < 0.001$). The median HR_{peak} for mSRT1 was 170 bpm (range, 138-224 bpm] and 177 bpm (range, 144-201

bpm) for mSRT2. The median peak RPE for mSRT1 was 14 (range, 7-18) and 11 (range, 7-18) for mSRT2. A positive correlation between the mSRT1 and BCTT for HR_{peak} (r_s = 0.396, $P < 0.0412$) was found. BCTT displayed the highest median HR_{peak} and peak RPE [HR_{peak}: 184 bpm (range, 140-201 bpm); RPE: 16 (range, 7-20)].

Conclusions: Based on preliminary results, youth participants attained a higher HR and RPE on the BCTT than the mSRT. Further research to better understand the effects of the test order, a heterogeneous sample, and including participants with concussion is warranted.

The Concurrent Validity of a Stationary Cycling Test of Exertion in Individuals Following a Sport-Related Concussion

Robert Graham,* Cody van Rassel, MKin,* Trevor Rutschmann, MSc,* Lauren Miutz, MS,* Bonnie Sutter, CAT(C),† and Kathryn Schneider, PT, PhD*,‡,§,¶,‖

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †University of Calgary Sport Medicine Centre, Calgary, AB, Canada; ‡Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada; §Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada; ¶Acute Sport Concussion Clinic, University of Calgary Sport Medicine Centre, Calgary, AB, Canada; and ‖Evidence Sport and Spinal Therapy, Calgary, AB, Canada.*

Objective: To evaluate the feasibility and concurrent validity of a new cycling test of exertion compared to the Buffalo Concussion Treadmill Test (BCTT) in adults following a sport-related concussion (SRC).

Study Design: Feasibility and concurrent validation study.

Subjects: Adults presenting to the Acute Sport Concussion Clinic aged 18 to 60 years who were diagnosed with a SRC.

Intervention: Participants completed both the BCTT and cycling test in a random order 48 hours apart. Prior to testing a ParMED-X was completed by the treating physician.

Outcome Measures: The primary outcome was maximum heart rate [HR_{max}; beats per minute (bpm)]. Secondary outcomes included Rating of Perceived Exertion (RPE; 6-20 as rated on the Borg scale), overall condition (11 point visual analog scale), test duration (minutes), and the symptom responsible for cessation of testing [Post Concussion Symptom Scale (PCSS) on the Sport Concussion Assessment Tool 5]. Testing was stopped once the participant achieved volitional fatigue or symptom threshold, defined as a ≥2 point change in their overall condition. Summary statistics were used to describe the sample and Spearman's Rho assessed agreement.

Results: Thirteen adults [median age = 28 (range 18-49); 7 males, 6 females] consented to participate in this study. The median HR_{max} on the BCTT was 171bpm [Interquartile range (IQR), 162-181] and on the bike was 171 bpm (IQR, 165-177) (r_s = 0.91; $P < 0.001$). The median duration of the treadmill test was 17 (IQR, 14-18) minutes and the bike was 17 (IQR, 14-21) minutes (r_s = 0.80; $P = 0.002$). For both tests, the most common symptoms responsible for test cessation were headaches, dizziness and pressure in the head. All participants were able to complete both tests and no adverse events were reported.

Conclusions: Scores on the BCTT and the cycling test of exertion were similar for HR_{max}, test duration, and symptoms responsible for test cessation. The cycling test of exertion appears to be feasible and could be a useful alternative to the BCTT.

Match Injuries Among High School Rugby Players in Calgary, Canada

Amanda M. Black, CAT(C), PhD,*,†,‡ Stacy R. Sick, BSc, CAT(C),* Paul H. Eliason, MSc,*,†,‡ Lauren N. Miutz, MS,*,†,‡ Brent E. Hagel, PhD,*,‡,§,¶ Luz Palacios-Derflingher, PhD,*,§ Kathryn J. Schneider, PT, PhD*,†,‡ and Carolyn A. Emery, PT, PhD*,†,‡,§,¶

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Canada; †Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Canada; ‡Alberta Children's Hospital Research Institute, Cumming School of Medicine, University of Calgary, Canada; §Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Canada; and ¶Department of Paediatrics, Cumming School of Medicine, University of Calgary, Canada.*

Objective: To estimate sex-specific injury rates in matches, including concussion rates, for rugby players (15-18 years) participating on high school teams in Calgary, Canada.

Study Design: Prospective cohort study.

Subjects: Male (n = 225) and female (n = 214) players were recruited from 15 teams (8 male, 7 female) in 6 high schools prior to the 2018 high school rugby season.

Observation Technique: A validated injury surveillance system captured baseline medical information, exposure and injury data.

Outcome Measures: A student trainer or study therapist completed an injury report form for injuries that required medical attention, resulted in the inability to complete the session of activity and/or led to the inability to do sporting activity for 1 day. A certified athletic therapist validated all injury report forms. Time-loss injuries were those resulting in the inability to participate in sporting activity for at least 1 day. Suspected concussions were based on the definition from the fifth International Consensus Statement on Concussion in Sport. Match-related incidence rates (IR) with 95% Confidence Intervals (CI) were estimated using Poisson regression adjusted for cluster by team and offset by player match exposure hours.

Results: There were 52 injuries in 225 male players (IR, 58.2; 95% CI, 35.4-95.9 per 1000 player-match-hours), including 21 concussions (IR, 23.5; 95% CI, 13.5-41.0 per 1000 player-match-hours) and 71 injuries in 214 female players (IR, 100.3; 95% CI, 74.0-136.1 per 1000 player-match-hours), including 38 concussions (IR, 53.7; 95% CI, 36.9-78.6 per 1000 player-match-hours). Time-loss injuries accounted for 42/52 male injuries (IR, 47.0; 95% CI, 28.7-77.0 per 1000 player-match-hours) and 61/71 female injuries (IR, 86.2; 95% CI, 68.5-108.5 per 1000 player-match-hours).

Conclusions: The match injury rate in high school rugby is higher in female than male leagues. Youth rugby injury prevention programs are needed.

Sport Participation and Injury Burden in High School Youth Volleyball Athletes

Derek W. Meeuwisse,* Amanda M. Black, CAT(C), PhD,*,†,‡ Kathryn J. Schneider, PT, PhD,*,†,‡,§,¶ Paul H. Eliason, MSc,*,†,‡ Stacy M. Kozak, MSc,*,‖ Carla van den Berg, MSc,* and Carolyn A. Emery, PT, PhD*,†,‡,‖,**,††

Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada; ‡Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada; §Acute Sport Concussion Clinic, Sport Medicine Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; ¶Evidence Sport and Spinal Therapy, Calgary, AB, Canada; ‖O'Brien Institute for Public Health, University of Calgary, Calgary, AB, Canada; **Community Health Sciences, Cumming School of Medicine, University of Calgary, Canada; and ††Department of Paediatrics, Cumming School of Medicine, University of Calgary, Canada.*

Objective: To identify the proportion of high school students (grades 10-12) that play volleyball in a high school, club or recreational setting and to identify the injury rate, type, body region and severity of volleyball injuries among high school students who report participating in volleyball.

Study Design: Cross-sectional survey.

Subjects: Thousand seven hundred one Alberta high school students (ages 14-19) completed the survey.

Observation Technique: A previously validated anonymous web-based cross-sectional survey was completed by Alberta high school students during class (October 2018-January 2019).

Outcome Measures: Self-reported participation in volleyball over the last year was recorded (based on top 3 selected sports for participation) in a high school, club or recreational setting. Outcome measures were described using proportions with 95% confidence intervals (CI) adjusted for cluster by school.

Results: Based on a preliminary analysis of 1686 participants who responded to the question related to sport participation, 228 (13.5%; 95% CI, 11.5%-15.8%) identified volleyball as one of their top 3 sports (141 female, 86 male, 1 preferred not to say). One hundred and forty-eight of 228 self-identified volleyball players participated in school (64.9%; 95% CI, 58.5%-70.9%) and 59/228 (25.9%; 95% CI, 20.6%-32.0%) participated as part of a club. Thirty-four participants listed a volleyball-related injury as the most serious injury over the last year (IR = 14.9 injuries/100 students reporting volleyball participation/year). The 2 most commonly injured body regions reported were the ankle (n = 12, 34.3%; 95% CI, 19.3%-53.3%) and the knee (n = 6, 17.1%; 95% CI, 7.3%-35.1%). The 2 most commonly reported injury types were a joint or ligament sprain (n = 10, 28.6%; 95% CI, 12.6%-52.6%) or a broken bone (n = 4, 11.4%; 95% CI, 5.5%-22.4%). Ten of the 34 (30.3%; 95% CI, 16.1%-49.6%) volleyball injuries reported took longer than 1 month to recover.

Conclusions: The majority of high school students in Alberta who participate in volleyball, play within a school setting. The most serious volleyball related injuries reported were ankle and knee injuries. Future research should focus on preventive measures for lower extremity injuries in youth volleyball.

Effect of an Injury Prevention Workshop on High School Basketball Coaches' Outcome Expectancies and Intentions

Anu M. Räisänen, PT, MHSc, PhD,* Oluwatoyosi B. A. Owoeye, PT, PhD,*,† Kati Pasanen, PT, MSc, PhD*,†,‡,§, Kimberley Befus, BKin,* Carla van den Berg, MSc,* and Carolyn A. Emery, PT, PhD*,†,‡,¶

Affiliations: *Sport Injury Prevention Research Centre, University of Calgary, Calgary, AB, Canada; †Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada; ‡McCaig Institute for Bone and Joint Health, University of Calgary, Calgary, AB, Canada; §Tampere Research Center of Sports Medicine, UKK Institute, Tampere, Finland; and ¶Department of Pediatrics and Community Health Sciences, Cumming School of Medicine, University of Calgary, AB, Canada.*

Objective: According to the Health Action Process Approach model, outcome expectancies can influence the intention to adopt preventative behaviours, such as implementation of an injury prevention program. The objective of this study was to examine the impact of a basketball injury prevention workshop on high school coaches' outcome expectancies and intentions.

Study Design: Pre-experimental design.

Subjects: Forty-four high school basketball coaches attending an educational workshop.

Intervention: A workshop on youth basketball injury prevention comprising of a theoretical session and a practical

session on a neuromuscular training (NMT) injury prevention warm-up program (SHRed Basketball Injuries).

Outcome Measures: Five statements adapted from previous research in youth sport injury prevention were used to assess outcome expectancies (basketball injuries are preventable/an NMT program prevents injuries/expectancies on athletes getting injured) and intentions (intent to implement the warm-up in practices/in games) on a 7-point Likert scale (1 strongly disagree—7 strongly agree) before and after the educational workshop. Wilcoxon matched-pairs signed-rank test with Bonferroni correction ($P = 0.05/5$) was used to assess statistical differences between the baseline and post-workshop ratings.

Results: In total, 38 coaches (67% male, age 39.5 years $\pm$ 10.5) completed baseline and post-workshop questionnaires. Participating coaches considered injury prevention to be important (agree 14%, strongly agree 86%). For outcome expectancies, there was significant changes towards increases in agreement on the preventability of basketball injuries ($P = 0.005$) but not on expectancies on NMT program participation preventing injuries ($P = 0.035$) or on expectancies of no athletes getting injured ($P = 0.076$). No changes were detected in the intention to implement the NMT program in practices ($P = 0.025$) or games ($P = 0.035$).

Conclusions: The workshop generated positive changes in coaches' expectancies on the preventability of basketball injuries. Further research is needed to evaluate the impact a workshop has on injury prevention behaviours, such as adoption, implementation and maintenance of an NMT injury prevention warm-up program.

Variability in Internal Load But Not External Load Is Associated With the Relationship Between Jump Load and Session RPE in Youth Basketball Players

Lauren Benson, PhD,* Carlyn Stilling, BS,* Kati Pasanen, PT, PhD,*,†,‡,§ and Carolyn Emery, PT, PhD*,‡,§,¶,‖

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Tampere Research Center of Sports Medicine, UKK Institute, Tampere, Finland; ‡Alberta Children's Hospital Research Institute, University of Calgary, AB, Canada; §McCaig Bone and Joint Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; ¶Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; and ‖Department of Pediatrics, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada.*

Objective: Fatigue (internal load) is a result of movement quantity (external load) in sport. As such, the objective was to determine the association of variability in external and internal load with the relationship between jump load and rating of perceived exertion (RPE) in youth basketball players.

Study Design: Cross-sectional.

Subjects: Sixty-one youth basketball players (38 F, 23 M) from 8 high school team.

Observation Technique: Players participated in basketball games and practices during a high school season (12-14 weeks), and a waist-worn commercially-available wearable device (VERT) recorded the number and height of jumps in each session. Player-reported RPE was recorded after each session using the CR10 Borg scale (range, 1-10).

Outcome Measures: Session RPE was RPE times session duration in minutes. The number and height of jumps were used to generate 4 jump load variables representing jump volume, bouts (<60 s between consecutive jumps), height and frequency. Subject-specific linear regression with 10-fold cross-validation modeled the relationship between jump load and session RPE. The root mean squared error (RMSE) represented the consistency of this relationship, with less error indicating a more consistent relationship between external and internal load. The association between RMSE and the variability (SD) of the jump load variables and session RPE was expressed as Pearson's correlation coefficient, with significance at $P < 0.05$.

Results: The mean session RPE for all players was 667.6 (range, 432.1-882.2). The mean RMSE was 220.6 (range, 87.6-338.0) across all subject-specific models. There was a significant moderate association between variability in session RPE and RMSE (r = 0.649, $P < 0.001$). The associations between variability in jump load variables and RMSE were weak and non-significant ($P > 0.05$).

Conclusions: Error in the relationship between jump load and session RPE indicates the degree to which participants had a different session RPE for similar jump load. The error is associated with variability in session RPE and not variability in jump load variables. Variability in session RPE may be due to unmeasured components of external load (eg, running, cumulative load) or inconsistencies in session duration or reported RPE. This should be considered in future studies where load modification strategies are based on external or internal training load.

Bone Mineral Density and Associated Factors in Female Pre-professional Dancers

Meghan L. Critchley, MSc,* Clodagh Toomey, PhD, PT,*,† Luz Palacios-Derflingher, PhD,*,‡ and Sarah J. Kenny, PhD*,†,§

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada; ‡Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; and §O'Brien Institute for Public Health, University of Calgary, Calgary, AB, Canada.*

Objective: To determine associated modifiable and non-modifiable factors with whole-body bone mineral density (BMD) in female pre-professional ballet and contemporary dancers.

Study Design: Cross-sectional.

Subjects: Full-time female pre-professional ballet and contemporary dancers were recruited in September 2015 from 2 dance training institutions in Calgary, Alberta.

Observation Technique: Prior to the start of the training season, dancers completed a baseline questionnaire comprised of demographics, previous dance training, and medical and injury history. Height (m) and weight (kg) were measured to estimate body mass index (BMI; kg/m^2).

Outcome Measures: Whole-body BMD (g/cm^2) was estimated from a dual-energy X-ray absorptiometry scan (DEXA, Hologic QDR 4500A scanner). Whole-body BMD was normalized for age and sex: "low BMD" = Z-score < -2.0 (yes/no). Descriptive statistics [proportions, means/95% confidence intervals (95% CI), and medians/ranges] were calculated. A regression tree identified important variables for inclusion in subsequent multivariable linear regression to examine associations with whole-body BMD. Potential interactions between covariables were considered.

Results: One hundred thirty-three full-time female pre-professional ballet [n = 74, median age 15.5 years (range, 11.3-19.2)] and contemporary [n = 59, median age 20.3 years (range, 17.9-30.4)] dancers participated. Mean whole-body BMD was 1.04 g/cm^2 (95% CI, 0.81-1.23). Low BMD was estimated in 2% (3/133) of participants. Age (years), previous dance training $\geq$3 times/week (years), calcium supplementation (yes/no), history of irregular menses (yes/no), MRI or bone scan (yes/no), and a one-year injury history (yes/no) were identified as important variables from the regression tree to be considered for subsequent modeling in linear regression. Age (β = 0.012, 95% CI, 0.007-0.017) and BMI (β = 0.016, 95% CI, 0.010-0.022) were significantly associated with whole-body BMD (R^2 = 0.55). One-year injury history did not modify or confound this relationship. No other variables were associated with whole-body BMD.

Conclusions: Age and BMI are significantly associated with whole-body BMD in female pre-professional ballet and contemporary dancers. Younger dancers with a low BMI are more likely to have low BMD. Future studies should consider associations with changing body composition over a training season and associations with increased dance-related injury in this high-risk population of pre-professional dancers.

Assessing Exercise Fidelity in Youth Basketball Players Performing the SHRED Injuries Basketball Neuromuscular Training Warm-up Program: A Reliability Study

Kimberley D. Befus, BKin,* Kati Pasanen, PT, PhD,*,†,‡,§ Anu M. Räisänen, PT, PhD,* Amanda M. Black, CAT(C), PhD,*,†,¶ Oluwatoyosi B. A. Owoeye, PT, PhD,*,† Tyler J. Tait, MSc,* Meghan H. McDonough, PhD,*,‖ and Carolyn A. Emery, PT, PhD*,†,‡,¶,‖,**

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada; ‡McCaig Institute for Bone and Joint Health, University of Calgary, Calgary, AB, Canada; §Tampere Research Center of Sports Medicine, UKK Institute, Tampere, Finland; ¶Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Canada; ‖O'Brien Institute for Public Health, Cumming School of Medicine, University of Calgary, Canada; and **Department of Pediatrics and Community Health Sciences, Cumming School of Medicine, University of Calgary, AB, Canada.*

Objective: The objective of this study was to determine the reliability of assessing exercise fidelity using video-analysis methods based on the performance of high school basketball players in the completion of the SHRED Injuries Basketball Neuromuscular Training (NMT) Warm-up.

Study Design: Reliability Study examining inter-rater reliability.

Subjects: Thirty-two youth club basketball players (11 females and 21 males) were video recorded (3 camera angles) while completing the SHRED Injuries Basketball NMT Warm-up as part of their normal practice routine.

Observation Technique: Three raters (R1, R2, R3) trained in the delivery of the NMT warm-up (R1, physiotherapist, 6 years; R2, NSCA-CSCS, 1 year; R3 basketball coach, 1 year of experience in NMT warm-up delivery) observed video clips and assessed exercise fidelity using the SHRED Injuries Basketball observation tool. Videos were divided into clips by exercise and player and then the order of review was randomized for each observer.

Outcome Measures: The SHRED Injuries Basketball observation tool is comprised of between 4 and 6 required components consisting of technique and volume for each of the 13 exercises. Each component was evaluated as whether they were fully (2 points), partially (1 points) or not completed (0 points). Inter-rater reliability was evaluated based on Kappa Agreement between component scores of expert physiotherapist (R1) and coaches (R2 and R3). A Kappa of 0.21 to 0.40 was considered fair and 0.41 to 0.60 moderate levels of agreement.

Results: The overall Kappa agreement between expert R1 and coach R2 was 0.46 with individual exercise kappa scores ranging between 0.24 and 0.60. R1 and CSCS R3 had an overall agreement of 0.34 with exercise scores between 0.09 and 0.52. Single Leg Jump had the lowest agreement and Skipping had the highest agreement for both.

Conclusions: The SHRED Injuries Basketball observation tool combined with training results in a fair to moderate level of observer agreement for assessment of exercise fidelity by people with varying degrees of professional certification and experience in NMT warm-up delivery, including trained competency to deliver a NMT warm-up program in youth basketball. More experience will be required to achieve higher levels of agreement with expert rater.

The Population-Based Impact of Hockey Canada's Changes to Body-Checking Rules

Alison Macpherson, PhD,*,† Andrew Wilton, MSc,†, and Ian Pike, PhD‡,§

Affiliations: *School of Kinesiology and Health Science, York University; †The Institute for Clinical Evaluative Sciences; ‡BC Injury Research and Prevention Unit; and §Department of Pediatrics, University of British Columbia.*

Objective: In 2013, Hockey Canada changed the age at which body-checking was introduced based on evidence that body-checking was associated with increased rates of injury when it was introduced at the PeeWee (11-12 years) age group compared with being introduced at the Bantam (13-14 years) age group. From 2013 onward, body-checking was introduced at the Bantam level. The objective of this study was to examine the population-based effect of Hockey Canada's policy change in Ontario, Canada.

Study Design: This is a longitudinal population-based study using routinely-collected administrative data. Data from all Emergency Department visits and hospitalizations are included. The analysis by division only included male hockey players.

Subjects: All injuries coded using the ICD-10 CA codes associated with a hockey injury were included. The denominator was the number of registered players in each age group. The rate per 100 000 players was calculated from 2008 to 2015.

Intervention: Policy change to the age at which body-checking is introduced.

Results: There were 14 687 hockey-related injuries in 2008, and 13 597 in 2015. Among PeeWee players, the rate of hockey injuries resulting from being struck by or striking another player was 3529 per 100 000 person years in 2008, and 3187 in 2015. By comparison, the Bantam rate was 6457 in 2008, and 7398 in 2015. In all divisions except PeeWee, the rates were either stable or increasing. The rate of hockey-related injuries due to falls in the PeeWee division was 2446 in 2008, and 3305 in 2015.

Conclusions: The results of this study suggest that the policy change that resulted in removing body-checking at the PeeWee level was associated with a decrease in the hockey-related injury rate at a population level. This supports previous studies in Alberta that found a reduction in injuries and concussions at the PeeWee level in Calgary following this policy change. Ongoing research can assess whether this change is maintained over time and across provinces. Further, these results can inform the decision about whether to remove body checking at the Bantam level.

Rate of Injury Associated With Body Checking Policy in Non-elite Midget Ice Hockey Players

Carolyn A. Emery, PT, PhD,*,†,‡,§,¶,‖ Paul Eliason, MSc,*,†,‡ Vineetha Warriyar K. V., PhD,* Luz Palacios-Derflingher, PhD,*,§ Amanda M. Black, CAT(C), PhD,*,†,‡ Maciej Krolikowski, MSc,* Nicole Spencer, MSc,* Kathryn J. Schneider, PT, PhD,*,†,‡,**,†† Shelina Babul, PhD,‡‡ Martin Mrazik, PhD,§§ Constance Lebrun, MD,¶¶,‖‖ Claude Goulet, PhD,*** Alison Macpherson, PhD,††† and Brent E. Hagel, PhD*,‡,§,¶,‖

Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; ‡Alberta Children's Hospital Research Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; §Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; ¶Department of Pediatrics, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; ‖O'Brien Institute for Public Health, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; **Sport Medicine Centre Acute Sport Concussion Clinic, University of Calgary, Calgary, AB, Canada; ††Evidence Sport and Spinal Therapy, Calgary, AB, Canada; ‡‡British Columbia Injury Research and Prevention Unit, Department of Pediatrics, University of British Columbia, Vancouver, BC, Canada; §§Faculty of Education, University of Alberta, Edmonton, AB, Canada; ¶¶Department of Family Medicine, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada; ‖‖Glen Sather Sports Medicine Clinic, University of Alberta, Edmonton, AB, Canada; ***Department of Physical Education, Faculty of Education, Université Laval, Quebec City, QC, Canada; and †††Faculty of Health, York University, Toronto, ON, Canada.*

Objective: To evaluate the rate of injury and concussion in games in non-elite Midget players following policy change disallowing body checking in games compared with similar leagues still allowing body checking.

Study Design: Prospective cohort.

Subjects: Midget players (ages 15-17) were recruited from teams in non-elite divisions of play (lower 80% by division of play) where policy disallowed body checking in lower divisions of play (Vancouver 2015-2016, Edmonton 2016-2017, and Calgary 2016-2018), and similar divisions of play where policy allowed body checking (Edmonton 2015-2017, Airdrie 2016-2018, and Calgary 2015-2018).

Observation Technique: A validated ice hockey injury surveillance methodology was used to collect baseline, exposure, and injury data over the 2015 to 2018 seasons.

Outcome Measures: All ice hockey-related injuries were identified by a team safety designate. Any player with a suspected concussion was referred to a study sport medicine physician for diagnosis. Multilevel mixed-effects Poisson regression was performed for each outcome with random effects at a team and subject level for game-related injury, and a random effect at the team level for game-related concussion.

Results: In total, 44 teams (453 player-records) from non-body checking divisions of play and 52 teams (667 player-records) from body checking divisions of play participated in the study; 115 players participated in more than one season. In divisions allowing body checking, there were 168 injuries [incidence rate (IR) = 25.19/100 players/season; 95% CI, 21.52-29.30] and 59 concussions (IR = 8.85/100 players/ season; 95% CI, 6.73-11.41) that occurred in games. In divisions not allowing body checking, there were 38 injuries (IR = 8.39/100 players/season; 95% CI, 5.94-11.51) and 18 concussions (IR = 3.97/100 players; 95% CI, 2.35-6.28) that occurred in games. Using multilevel mixed-effects Poisson regression, policy disallowing body checking was associated with a lower rate of all injury [rate ratio (RR) =

0.29; 95% CI, 0.20-0.43), and concussion (RR = 0.41; 95% CI, 0.24-0.70).

Conclusions: Introduction of policy disallowing body checking in Midget non-elite levels of play resulted in a 71% lower rate of injury and 59% lower rate of concussion. These findings have important implications for policy change informing a reduction in the public health burden of injury and concussion in Midget aged youth ice hockey players.

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Platelet-Rich Plasma Therapy for Tendinopathy: Comparative Effectiveness of Patient-Reported Outcomes

Constance Lebrun, MDCM, MPE,* Teresa De Freitas, BScN, MD,* Ann-Marie Przyslupski, MSc,* Rebecca Reif,† and Taryn Wicijowski, BSc†

*Affiliations: *Department of Family Medicine, Glen Sather Sports Medicine Clinic, University of Alberta, Edmonton, AB, Canada; and †University of Alberta, Edmonton, AB, Canada.*

Objective: To assess efficacy of platelet-rich-plasma (PRP) treatment for tendinopathy through patient-reported outcomes.

Study Design: Cross-sectional retrospective chart review.

Subjects: Patients who received PRP injections at the Glen Sather Sports Medicine Clinic for tendinopathy between January 2010 and June 2018. Of 643 patient records (47.10 ± 13.54 years) identified, only patients who completed both pre- and post-PRP Visual Analogue Scale (VAS) questionnaires were included for analysis (n = 391; 48.49 ± 13.36 years). Data were analyzed using descriptive statistics, t-tests, and repeated measures analyses.

Observation Technique: Chart review of electronic medical records (HealthQuest).

Outcome Measures: VAS analysis (Domains: pain, functional limitation, physical activity) before/after PRP injection in the affected joint (ie ankle, knee, shoulder, hip, elbow, other).

Results: Reduced pain following initial PRP injection was reported for most areas (ankle: $P = 0.019$; CI, -1.14 to -0.11; n = 97; knee: $P = 0.0024$; CI, -2.25 to -0.53; n = 39; hip: $P = 0.0023$; CI, -1.63 to -0.37; n = 61; shoulder: $P < 0.0001$; CI, -1.48 to -0.49; n = 109; elbow: $P = 0.00020$; CI, -1.47 to -0.35; n = 75). Overall, patients reported reduced limitation with functional activities of daily living (ADL); ankle: $P < 0.001$; CI, -2.18 to -1.27; n = 97; knee: $P = 0.00045$; CI, -2.42 to -0.75; n = 39; hip: $P < 0.0001$; CI, -2.28 to -1.23; n = 61; shoulder: $P < 0.0001$; CI, -1.78 to -0.91; n = 109; elbow: $P = 0.00061$; CI, -1.42 to -0.41; n = 75). Improved physical activity was demonstrated for all areas assessed (ankle: $P < 0.001$; CI, -3.20 to -2.11; n = 97;

knee: $P < 0.0001$; CI, -3.54 to -1.82; n = 39; hip: $P < 0.0001$; CI, -2.65 to -1.52; n = 61; shoulder: $P < 0.0001$; CI, -2.46 to -1.58; n = 109; elbow: $P < 0.0001$; CI, -2.32 to -1.12; n = 75; other (ie, foot, hand): $P = 0.011$; CI, -5.08 to -0.88; n = 11).

Of patients receiving a second PRP injection (ankle: 20%, n = 32/160; knee: 47.8% n = 42/88; hip: 42.5%; n = 43/101; shoulder: 58%, n = 87/150, elbow: 53.3%, n = 65/122), benefit was reported only for hip ADL function ($P = 0.023$; CI, -1.74 to -0.13; n = 15) and physical activity for ankle ($P = 0.0016$; CI, -1.49 to -0.48; n = 10) and elbow ($P = 0.040$; CI, -0.05 to -2.13; n = 12) tendinopathy.

Conclusions: Provisional results suggest PRP may be a promising therapy for tendinopathy. Supplementary PRP injections may not sustain pain relief for all joints, demonstrating need for additional modes of management. Coordinated efforts by clinic stakeholders are essential for standardized electronic record charting and follow-up. A controlled prospective study is recommended to further validate these results.

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Platelet-Rich Plasma Therapy for Osteoarthritis: Comparative Effectiveness of Patient-Reported Outcomes

Constance Lebrun, MDCM, MPE,* Teresa De Freitas, BScN, MD,* Ann-Marie Przyslupski, MSc,* Taryn Wicijowski, BSc,† and Rebecca Reif†

*Affiliations: *Department of Family Medicine, Glen Sather Sports Medicine Clinic, University of Alberta, Edmonton, AB, Canada; and †University of Alberta, Edmonton, AB, Canada.*

Objective: To assess efficacy of platelet-rich-plasma (PRP) therapy for osteoarthritis through patient-reported outcomes.

Study Design: Cross-sectional retrospective chart review.

Subjects: Patients who received PRP injections for osteoarthritis at the Glen Sather Sports Medicine Clinic between January 2010 and June 2018 (n = 143; 60.39 ± 11.47 years); only patients who completed both pre- and post-PRP Visual Analogue Scale (VAS) questionnaires were included for analysis (n = 69; 61.05 ± 12.61 years). Data were analyzed using descriptive statistics, t-tests, and repeated measures analyses.

Observation Technique: Chart review of electronic medical records (HealthQuest).

Outcome Measures: Visual Analogue Scale (VAS) analysis (Domains: pain, functional limitation, physical activity) before and after PRP injection(s) into the affected joint (ie, knee, shoulder, hip, other).

Results: Patients with OA reported that an initial PRP treatment improved functional activities of daily living (ADL) for knee OA ($P = 0.0005$; CI, -2.73 to -0.85; n = 33), shoulder OA ($P = 0.042$; CI, -2.68 to -0.06; n = 17), and other OA (elbow, ankle/foot) ($P = 0.0024$; CI, -4.24 to -1.36; n = 8). There was also improvement in perceived physical activity following PRP treatment: knee OA ($P < 0.0001$; CI, -3.58 to -1.54; n = 33), hip OA ($P = 0.037$; CI, -2.97 to -0.12; n = 11), shoulder OA ($P = 0.0021$; CI, -3.33 to -0.88; n = 17) and other OA (elbow, ankle/foot) ($P = 0.021$, CI, -2.83 to -0.32; n = 8). Sustained pain

reduction was reported by other (elbow, ankle/foot) OA patients only ($P = 0.00061$; CI, -4.19 to -1.79; n = 8).

Of OA patients who received a second PRP injection, nearly 22% (n = 31/143) presented with knee OA, 36% (n = 5/14) with hip OA, 12.5% (n = 3/24) with shoulder OA, and 11% (n = 1/9) with other OA (ankle). Only patients receiving a second PRP injection for knee OA (33%; n = 7) reported significant improvement in pain ($P = 0.039$; CI, -3.50 to -0.12), ADL function ($P = 0.014$; CI, -6.12 to -1.05) and physical activity ($P = 0.012$; CI, -5.07 to -0.93).

Conclusions: Our interim analyses report effectiveness of PRP therapy for OA in various joints with differential effects on pain, ADL function, and physical activity ability. Supplementary PRP injections may not provide sustained pain relief for all joints, demonstrating a need for additional modes of OA management. Coordinated efforts by clinic stakeholders are essential for standardized electronic record charting and consistent patient follow-up. A controlled prospective study is recommended to further validate these results.

The Effect of High-Intensity Exercise on Measures of Cervical Spine Function and Oculomotor and Vestibulo-Ocular Function in University Level Collision and Combative Sport Athletes

Tin Jasinovic, MD,* Ben Cameron, MD,*,† Victor Lun, MSc, MD,*,† Cody van Rassel,‡ Bonnie Sutter, CAT(C), DOMP,† Preston Wiley, MPE, MD,*,†,‡ and Kathryn Schneider, BHScPT, PhD†,§,¶

*Affiliations: *Department of Family Medicine, Cumming School of Medicine, University of Calgary; †University of Calgary Sport Medicine Center, Calgary, AB, Canada; ‡Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; §Alberta Children's Hospital Research Institute, Calgary, AB, Canada; and ¶Hotchkiss Brain Institute, Cummings School of Medicine, University of Calgary, Calgary, AB, Canada.*

Objective: To determine the effect of high-intensity exercise on measures of cervical spine function and oculomotor and vestibulo-ocular function in university level collision and combative sport athletes.

Study Design: Case series.

Subjects: University of Calgary women's rugby, men's wrestling and women's wrestling athletes.

Intervention: Subjects completed the outcome measures at rest and immediately after completing the 30 to 15 Intermittent Fitness Test.

Outcome Measures:
1. Cervical spine function: cervical flexor endurance (CFE), head perturbation test (HPT), cervical flexion rotation test (CFRT) and anterolateral strength.
2. Oculomotor and vestibulo-ocular (OVO) function: A quantified version of the Vestibular Ocular Motor Screen (VOMS), head thrust test (HTT) and a clinical test of dynamic visual acuity (DVA).

The agreement between scores at rest and post-exertion was assessed using Bland-Altman 95% Limits of Agreement for continuous measures and Cohen's kappa (κ) for dichotomous and ordinal variables.

Results: A total of 37 varsity athletes [median age = 19 years (range, 17-23)] participated in this study (22 female rugby and 9 male and 6 female wrestling). A previous history of concussion was reported by 21 athletes. On average, cervical spine function (CFE, HPT, and CFRT), OVO function (VOMS), and OVO (HTT and DVA) measures were performed 9.76 (range, 1.0-32.0), 15.76 (0.0-32.0) and 9.19 (1.0-21.0) minutes after stopping exercise, respectively. Summary statistics by sex and sport will be presented for all measures. Novel findings included the following: After log transformation, the mean difference in CFE following exercise testing was 1.00 seconds [95% Confidence Interval (CI), 0.85-1.18] and the 95% Limits of Agreement were (0.39-2.57). Median near point of convergence (NPC) was 7 cm [Interquartile range (IQR), 4.66-11.67] prior to exertion and 7.5 cm (4.0-8.17) following exertion ($z = -2.10$; $P = 0.036$). Cervical spine anterolateral flexion strength on the right was similar to pretesting ($z = -1.43$; $P = 0.15$) whereas to the left it was different ($z = -3.94$; $P = 0.0001$). One athlete scored 7/8 on the head perturbation test at baseline and all athletes scored 8/8 following exertion testing.

Conclusions: High-intensity exercise did not have a consistent effect on cervical spine function, oculomotor and vestibulo-ocular function in university level collision and combative sport athletes.

The Effect of High-Intensity Exercise on Sport Concussion Assessment Tool 5 (SCAT5) Values in University Level Collision and Combative Sport Athletes

Tin Jasinovic, MD,* Ben Cameron, MD,*,† Victor Lun, MSc, MD,*,† Cody van Rassel, MKin,‡ Bonnie Sutter, BPE, BEd, CAT(C), DOMP,† Preston Wiley, MPE, MD,*,†,‡ and Kathryn Schneider, BHScPT, PhD†,‡,§,¶

*Affiliations: *Department of Family Medicine, Cumming School of Medicine, University of Calgary; †University of Calgary Sport Medicine Center, Calgary, AB, Canada; ‡Sport Injury Prevention Research Centre, University of Calgary, Calgary, AB, Canada; §Alberta Children's Hospital Research Institute, Calgary, AB, Canada; and ¶Hotchkiss Brain Institute, Cummings School of Medicine, University of Calgary, Calgary, AB, Canada.*

Objective: To determine the effect of high-intensity exercise on SCAT5 values in university level collision and combative sport athletes.

Study Design: Prospective case series.

Subjects: University of Calgary women's rugby, men's wrestling and women's wrestling athletes.

Intervention: Subjects completed SCAT5 questionnaires at rest (REST) and after completing the 30 to 15 Intermittent Fitness Test (Post-Ex).

Outcome Measures: SCAT5 subscale scores were the outcome measures of the study. The agreement between scores at REST and Post-Ex was assessed using Bland-Altman

95% Limits of Agreement for continuous measures (or Wilcoxon signed rank as appropriate depending on the distribution of the data).

Results: A total of 37 varsity athletes [median age = 19 years (range, 17-23)] completed REST and Post-Ex SCAT5s (22 women's rugby and 9 men's and 6 women's wrestling). A previous history of concussion was reported by 21/35 athletes. On average, the Post-Ex SCAT5 was assessed 20.0 (range, 1.0-47.0) minutes after stopping exercise. There was no difference in the total number of symptoms reported or symptom severity score following exercise (z = 0.74, P = 0.46; z = −1.02, P = 0.31 respectively). Median REST rating of percentage of normal was 95% (IQR, 87%-100%) and Post-Ex was 90% (IQR, 90-100) (z = 1.05, P = 0.29). Immediate 10 word recall score was not different following exercise [Median REST = 21 (IQR, 18-22) and Post-Ex = 21 (19-24) z = −0.92, P = 0.36] nor was delayed 10 word recall [Median 7 (IQR, 5-8) for both REST and Post-Ex (z = −0.18, P = 0.86)]. There was no difference in concentration score [Median REST = 4 (IQR, 3-5) and Post-Ex = 5 (IQR, 3-5) (z = −1.87, P = 0.062)] or balance examination score [Median REST = 5 (IQR, 2-7) and Post-Ex = 5 (IQR, 2-7) (z = 0.37, P = 0.71)].

Conclusions: SCAT5 scores did not change after high intensity exercise in university level collision and combative sport athletes.

Interdiscipinary Shoulder Pain Care: Assessment of a Novel Collaborative Model and Clinical Process Outcomes

Teresa De Freitas, BScN, MD, CCFP (SEM), Ann-Marie Przyslupski, MSc, and Constance Lebrun, MDCM, MPE, CCFP (SEM)

Affiliation: Glen Sather Sports Medicine Clinic, Department of Family Medicine, University of Alberta, Edmonton AB, Canada.

Objective: We aim to evaluate if surgical referral triaging by a surgeon into interdisciplinary surgical or non-surgical care demonstrates reduced surgical wait times (compared to the Alberta average). We also aim to assess if an interdisciplinary same-day team approach—orthopaedic surgeon or sport and exercise medicine physician (SEM) plus a physiotherapist—will contribute to improving patient function over time regarding their shoulder pain. This study is currently in progress.

Study Design: Program Evaluation, Survey Research.

Subjects: New English-speaking patients (≤18 years) referred to a GSSMC Shoulder Clinic (SURG/SEM) for shoulder pain. Our data (May 29, 2017-December 31, 2018; n = 275) were analyzed for descriptive statistics, with t-tests and two-way ANOVAs conducted to determine statistical significance.

Observation Technique: Three validated shoulder pain questionnaires (WORC, WOSI, DASH; rotator cuff, shoulder instability, and work/ability-related quality of life) with follow-ups at 3 and 6-months.

Outcome Measures: Age, sex, referral-to-appointment time, referral-to-surgery time, WORC/WOSI/DASH scores, treatments received.

Results: Currently we report no significant difference between SEM and SURG referral wait-times with our orthopaedic triaging model (P < 0.14; SEM (109.8 days, n = 72), SURG (133.8 days, n = 203). Of 116 SURG patients consenting to surgery, 14 (12.1%) received surgery within 6 months of seeing an orthopaedic surgeon. To date, 18.1% (n = 21) of consenting SURG patients have received surgery, with an average wait time of 122.5 ± 101.8 days). Of those triaged to the SEM arm, 8 patients (11.1%) were referred back to an orthopaedic surgeon. Survey responses do not indicate any significant differences at any of the follow-up periods between SURG and SEM shoulder pain patients. No significant differences are currently seen for any reporting period for patients referred to the non-surgical SEM treatment arm. WOSI scores decreased significantly at the 6-month period (P < 0.00064) in the SURG group only, indicating improved function for patients with shoulder instability. Of these patients, WOSI scores between surgical waitlist patients (55.35 ± 24.55, n = 43) and patients who have received surgery (68.84 ± 20.56, n = 6) did not differ (P = 0.21).

Conclusions: We report overall success of our collaborative shoulder team care model in reducing shoulder pain within 6-months for SURG patients with shoulder instability. Our triaging model does not appear to reduce clinical referral or surgical wait-times at this point.

Evaluation of Novel Clinical Measures and Technology in Healthy Youth: Relevant Measures for Concussion Assessment?

K. J. Schneider PT, PhD,*,†,‡,§,¶ A. D. Harris, PhD,†,‡,‖ C. van Rassel, MKin,* G. Kuntze, PhD,*,† M. Adly, T. Rutschmann, MSc,* D. Meeuwisse,* S. Virani, MSc,*,** G. M. Schneider, PT, PhD,¶,‖ C. A. Emery, PT, PhD*,†,‡ and T. Cluff, PhD‡

*Affiliations: *Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; †Alberta Children's Hospital Research Institute, University of Calgary, Calgary, AB, Canada; ‡Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada; §Acute Sport Concussion Clinic, Sport Medicine Centre, Faculty of Kinesiology, University of Calgary, Calgary, AB, Canada; ¶Evidence Sport and Spinal Therapy, Calgary, AB, Canada; and ‖Department of Radiology, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada; and **Neurosciences Program, Alberta Children's Hospital, Calgary, AB, Canada.*

Objective: Evaluate the feasibility and association between technological and clinical tests (ie, cervical, balance, vestibulo-ocular, oculomotor and sensory function) that may be relevant for concussion assessment in youth.

Study Design: Cross sectional and concurrent validation study.

Subjects: Uninjured youth athletes aged 10 to 17 years.

Observation Technique: Participants attended a 1-day testing session and were screened by the study therapist. Participants then completed technological and clinical

measures of cervical, vestibulo-ocular, oculomotor, balance, and sensory function.

Outcome measures: (1) Cervical spine range of motion and isometric strength [Multi-Cervical Unit (MCU) (lbs) versus hand held dynamometer (lbs)]; (2) standing balance [balance examination score (number of errors) vs NeuroCom SmartEquiTest]; (3) Dynamic balance [Functional Gait Assessment vs GaitRITE computerized mat]; (4) Vestibulo-ocular reflex [Head thrust test (positive/negative) versus ICS video Head Impulse test (gain), clinical dynamic visual acuity (logMar) versus InVision computerized dynamic visual acuity (logMar)]; (5) oculomotor [clinician observed oculomotor function (normal/abnormal) versus ICS Oculomotor test battery]; (6) heat/cold and pressure pain thresholds (TSA Neurosensory Analyzer), vibrotactile stimulus (tuning fork vs Brain Gauge vibrotactile stimulator) and (7) the KINARM exoskeleton robot.

Results: Twenty-six youth (16 male, 10 female; ages 10-17) participated. Previous concussion was reported by 10/26 (38.5%) of participants. No adverse events were reported. Feasibility was demonstrated for the clinical tests as all participants were able to perform all clinical tests. Technology-based tests were feasible in all except for one subject who was unable to complete the MCU testing as she was too short for her head to be positioned properly in the halo. Reference values by sex for all tests will be reported. Novel findings included no association between tests technological and clinical function for vestibulo-ocular reflex tests and cervical spine strength ($r_s = -0, 12\text{-}0.11$; $P = 0.58\text{-}0.96$).

Conclusions: Clinical and technological tests are feasible in the majority of youth. No association was identified between clinical tests and technological tests of VOR and cervical spine strength. Further research to optimize clinical assessment measures, assess reliability of and understand the effects of growth and development and concussion on changes in scores will better inform the use of these measures in youth clinically and in research.

The Relationship Between Saliva Cortisol Measures, Symptom Burden, Length of Recovery and Concussion History Following Pediatric Sport-Related Concussion

Parker L. La, BSc,*,†,‡ Gregory A. Kline, MD,§ Amanda Black, PhD,‡,¶,‖ Katherine Wynne-Edwards, PhD,‡ Kathryn Schneider, PhD,‡,¶,‖ Carolyn A. Emery, PhD,‡,¶,‖ and Chantel T. Debert, MD, MSc†,‡,¶

Affiliations: *Faculty of Science, University of Calgary, Calgary, AB, Canada; †Department of Clinical Neuroscience, University of Calgary, Calgary, AB, Canada; ‡Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada; §Division of Endocrinology, University of Calgary, Calgary, AB, Canada; ¶Department of Kinesiology, University of Calgary, Calgary, AB, Canada; and ‖Sport Injury Prevention Research Centre, University of Calgary, Calgary, AB, Canada.*

Objective: Currently no one fluid biomarker can predict recovery in sport-related concussion (SRC). Previous studies have shown alterations in acute serum cortisol correlates to increase symptom burden and prolonged recovery in more severe traumatic brain injuries. The primary aim of this study was to determine if acute salivary cortisol correlate to symptom burden and length of return to activity (RTA) following SRC in adolescent hockey players. Secondary aims explored whether a previous associated stressful event, such as prior concussion, would influence post-SRC symptom burden, and length of RTA.

Study Design: Prospective cohort study.

Subjects: Athletes aged 11 to 18 were evaluated throughout 5 hockey seasons (2013-2018) as part of the "Safe to Play" study.

Observation Technique: Athletes were followed throughout the hockey season. If concussed, a morning saliva sample (7-10 AM) and clinical assessment (including SCAT3) was completed within 1 week of injury.

Outcome Measures: Salivary samples were analyzed for cortisol using high pressure liquid chromatography-mass spectrometry. Linear regression analyzed the relationship between post-SRC cortisol, symptom burden and RTA adjusted for age and sex. Binary logistical regression analysis determined the relationship between concussion history, symptom burden and RTA. Adjusted odds ratio and 95% confidence intervals were calculated for each model and adjusted for age and sex. Significant values were determined to be $P < 0.05$.

Results: One hundred four athletes provided saliva, of these 68 (14.04 ± 0.17 years, 80.9% male) were included. Loss of samples were due to use of medication with a steroid component (n = 9), timing of sample provided (n = 51) and insufficient sample provided (n = 5). A higher post-SRC saliva cortisol predicted increase in severity of symptoms [adjusted OD (95% CI) 0.017 (0.002-0.032); $P = 0.029$], but not symptom number [0.039 (0.005-0.083); $P = 0.083$], or length of RTA [0.001 (0.023-0.026); $P = 0.916$]. Following SRC, players with a previous concussion history demonstrated significantly higher symptom number [1.041 (1.010-1.070); $P = 0.008$], symptom severity [1.129 (1.040-1.226); $P = 0.004$], and length of RTA [1.140 (1.03-1.261); $P = 0.011$], compared to athletes without history of concussion. Age and sex did not influence the models.

Conclusions: Following SRC, increased morning cortisol is associated with greater symptom severity. Concussion history relates to greater symptom burden and longer RTA suggesting a prior concussion, can influence post-SRC symptoms, recovery and cortisol "stress" response.