2024 CASEM Podium Presentation Abstracts

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Long-Term Quality of Life and Clinical Outcomes of a Randomized Clinical Trial Comparing Patellar Tendon, Hamstring Tendon, and Double-Bundle Hamstring ACL Reconstructions at 10 Years Postoperatively

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Objective: To compare disease-specific quality of life and clinical outcomes at 10 years after reconstruction for ACL deficiency using a patellar tendon (PT), single-bundle quadruple-stranded hamstring tendon (HT), or double-bundle (DB) hamstring tendon construct.

Study Design: Prospective, double-blind randomized clinical trial.

Subjects: Three hundred and thirty patients (183 male patients; 14-50 years), with confirmed anterior cruciate ligament deficiency.

Intervention: Patients (110/group) were intraoperatively randomized (computer-generated, varied block) to anatomic ACL reconstruction with: PT (mean age 28.7 years), HT (mean age 28.5 years), or DB (mean age 28.3 years) autografts. Patients and an independent trained examiner were blinded to treatment allocation.

Outcome Measures: Outcomes were measured at baseline and 2, 5, and 10 years postoperatively. Primary: Anterior Cruciate Ligament Quality of Life (ACL-QOL). Secondary: IKDC subjective and objective scores, pivot shift, kneeling pain, Tegner activity, Cincinnati Occupational Scale, Single Leg Hop. Proportions of complete reruptures, partial reruptures, and combined total traumatic reinjuries were compared.

An analysis of variance for repeated measures compared continuous data; χ^2 analyses compared categorical data, with a 5% significance level.

Results: Two hundred and eighty seven patients (87%) completed 10-year follow-up (mean 10.2 ± 1.2 years), 6 withdrawals, 1 deceased, 36 lost to follow-up. Demographic characteristics of patients with 10-year follow-up were not different between groups. ACL-QOL scores increased from baseline to 10 years for all groups ($P < 0.001$). The mean 10-year ACL-QOL scores were not different ($P = 0.912$): PT = 76.4 ± 21.0 (95% CI 72.1-80.7); HT = 77.7 ± 20.5 (95% CI 73.4-81.9); DB = 77.3 ± 21.5 (95% CI: 73.0-81.7). The proportion of patients with a pivot shift grade ≥2 (PT = 18%; HT = 25%; DB = 24%) was not statistically significant between groups ($P = 0.866$) but is clinically important. None of the secondary outcomes at 10 years were different between groups, including kneeling pain (PT = 6%; HT = 4%; DB = 7%; $P = 0.637$).

There were more complete traumatic graft ruptures in the HT and DB groups (HT = 16%; DB = 15%) compared with patellar tendon reconstructions (PT = 7%; $P = 0.142$). Revision ACL reconstruction was performed on 36 of these 37 patients. Twelve additional patients had partial graft reruptures (PT = 1; HT = 5; DB = 6) with cumulatively less traumatic reinjuries in the PT group (PT = 8/95; HT = 21/93; DB = 21/99, $P = 0.023$).

Conclusions: At 10 years, there was no difference in disease-specific ACL quality of life outcome between the three ACL reconstructions, but significantly more traumatic reinjuries in the HT and DB than the PT group.

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Is There a 'Doug Henning Placebo Effect' Associated With Platelet-Rich Plasma Knee Injections For Osteoarthritis? A Randomized, Controlled Trial

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Objective: To evaluate the therapeutic effect and perceived efficacy in patients who observe the procedural preparation of a PRP injection in full in comparison with patients who do not observe preparation before injection.

Study Design: Prospective, single-center, randomized controlled trial

Subjects: We included 120 participants older than 40 years with a diagnosis of symptomatic knee OA. Patients with inflammatory OA, open wounds or sores over the knee joint, and/or previous PRP injection were excluded.

Interventions: Participants in the treatment group watched the centrifugation and detailed extraction of blood separated components to reveal PRP injection fraction, after which an injection was given. Patients in the control group left the room during preparation procedures and received the injection only.

Outcome measures: The primary outcome was the between-group difference in pain as measured by the Visual Analog Scale (VAS) at the 3- and 6-month time points. Secondary outcomes were also assessed at 3- and 6-month postinjection and included (1) Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), (2) SF-12 questionnaire, (3) knee range of motion, and (4) return to previous level of activity. Patients were also asked to report on their belief regarding the ability of the treatment to successfully relieve pain before and immediately after the injection (at the initial visit only).

Results: Overall, no significant between-group differences were observed in any of the outcome measures. There was a 2.3-fold increase in positive perception of a major effect in patients who observed PRP preparation compared with those

who did not (17% vs 7.4%); however, this did not reach statistical significance. A significant decrease in VAS pain and WOMAC pain scores was seen in both groups, as well as a significant improvement in WOMAC functional and total scores and SF-12 physical scores at 3 and 6 months.

Conclusions: We did not identify any between-group differences in patient-reported outcome measures or knee range of motion; however, a larger sample size is likely required to draw definitive conclusions on the impact of the Doug Henning Placebo Effect.

Transforming Musculoskeletal Care for Albertans Using Standardized Clinical Decision-Making Pathways for Shoulder, Low Back, and Soft Tissue Knee Conditions

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Objective: To develop standardized provincial, evidence-informed primary care decision-making pathways for optimizing assessment, diagnosis, and management of shoulder, low back, and soft tissue knee conditions in Alberta, respectively.

Study Design: Systematic rapid reviews to inform modified Delphi consensus methods.

Subjects: Subject matter experts were invited to participate in the development of three clinical pathways. Experts were purposively selected to represent a range of disciplines/expertise (eg, family medicine, sports medicine, orthopaedic surgery, radiology, physiatry, athletic therapy, physical therapy, occupational therapy, public policy, and healthcare administration) and geographic health regions across Alberta.

Intervention: Development of the clinical pathways underwent (1) completion of a rapid review, (2) selection of experts, and (3) implementation of a four-round modified Delphi voting process.

Outcome: Consensus was reached for three standardized provincial primary care decision-making clinical pathways.

Results: Each pathway outlines the steps in the clinical decision-making process for primary care providers practicing in both public and private settings. Each pathway consists of clinical examination algorithms, triage decision-making aids that include history-taking and physical examination criteria, appropriate use criteria for diagnostic imaging, and treatment/management recommendations.

Conclusions: Clinical pathways improve patient access and quality of care by providing guidance on best practice and decreasing variance in practice across the continuum of care, while reducing unnecessary wait times and healthcare expenditures. Pathway development was an initiative of Alberta Health Services' Bone and Joint Health Strategic Clinical Network's (BJH SCN) MSK Transformation Program.

Acknowledgements: The authors would like to thank the members of the Provincial Expert Delphi Groups who contributed to the development of the clinical decision-making pathways.

Randomized Clinical Feasibility Trial: Comparing a Restrictive and Protective Range of Motion Brace for the Nonsurgical Management of the Medial Collateral Ligament of the Knee

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Objectives: (1) Determine differences in medial collateral ligament (MCL) laxity in patients with acute MCL injuries treated nonoperatively using one of two range of motion (ROM) knee brace settings. (2) Examine differences in knee ROM, brace satisfaction, overall knee score, adherence, pain, quality of life, and knee function.

Study Design: Prospective, randomized, single-blinded feasibility clinical trial.

Subjects: 60 adult patients (27 males, 33 females) with acute moderate-to-severe isolated MCL or combined ACL-MCL injuries seen at the University of Calgary Sport Medicine Centre (SMC).

Intervention Technique: Patients were randomly assigned to (1) the protected brace group (0-90° (°)) or (2) the restricted brace group (30-90 degrees). Patients were prescribed constant brace wearing for four weeks and then daytime wear only until brace discontinuation at six weeks. Rehabilitation exercises were prescribed from two weeks onward. Patients were followed for 12 weeks.

Outcome Measures: The primary clinical measures were side to side differences (SSD) in MCL laxity (mm) at 0° and 30-degree knee flexion and knee ROM. Patient-reported outcome measures included pain on a VAS (Visual Analog Scale), overall knee score (Single Assessment Numeric Evaluation (SANE)), brace satisfaction (modified Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2.0)), and brace adherence (daily online log), collected at baseline, 2, 4, 6, 8, and 12 weeks. Patients completed the ACL-QOL and the IKDC subjective questionnaires at baseline and 12 weeks. The outcome assessor was blinded to treatment group allocation.

Results: At 12 weeks, 73% of patients had less than 1-mm SSD valgus laxity at 30-degree knee flexion, with a greater proportion in the restricted group at 82% compared with the protected group at 67%. This approached statistical significance at $P = 0.13$. All patients reported improved pain, and none suffered a loss of knee ROM at 12 weeks. Patients braced

30 to 90 degrees reported greater adherence, brace satisfaction, function, overall knee scores, and QOL (quality of life).

Conclusions: This feasibility trial favors bracing moderate and severe MCL injuries at 30 to 90 degrees for 6 weeks.

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The Clinical Utility of a Novel Multimodal Neurological Assessment Battery in Detecting Physiological Impairment In Athletes Sustaining an Acute Sport-Related Concussion

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Objective: To determine the clinical utility of a novel, multimodal, neurological assessment battery in detecting acute postconcussion physiological impairment relative to healthy baseline.

Study Design: Prospective observational cohort study.

Subjects: Four hundred thirty-one elite ice hockey, alpine and freestyle ski, and luge athletes (mean age: 15.7 years (range: 14-36 years), male: 349, female: 82) over one athletic season (2022-2023).

Observation Technique: Standardized multimodal baseline assessments including electroencephalography (EEG), postural sway, sustained grip strength, and cardiovascular exercise were completed in the preseason and then repeated for any athlete sustaining a physician diagnosed sport-related concussion within seven days of injury.

Outcome Measures: Directional bootstrap paired *t*-tests and binomial tests adjusting for multiplicity using Bonferroni correction were used to assess changes in performance between baseline and postconcussion test results for the following four primary assessments of interest: (1) quantitative EEG event-related potentials (N100, P300, and N400 amplitude and latency) (NeuroCatch), (2) quantitative assessment of postural sway with eyes open and eyes closed using a physiological vibration acceleration () sensor (Protxx), (3) concussion symptom exacerbation (≥1 on a 10-point visual analog rating scale) during a submaximal cycle ergometer assessment, and (4) change in heart rate during a 30-second, 30% maximal grip strength contraction.

Results: Forty-six athletes were diagnosed with a concussion. Neither amplitude nor latency for N100, P300, or N400 event-related potentials demonstrated a significant group difference between phybrata baseline and postconcussion assessments. Athletes demonstrated a significant group difference in postural sway with a moderate effect size (dav = 0.491) using the phybrata sensor between baseline and postconcussion time points for mean sway power ratio (baseline: 1.4 ± 0.5 W, postconcussion: 1.9 ± 1.4 W, $P = 0.005$). Fourteen (66.7%) of the 21 athletes completing postconcussion exercise assessments experienced worsening symptoms, with three additional athletes unable to initiate exercise due to significant symptom burden ($P < 0.001$, large effect size $d_{av} = 0.972$). Furthermore, no significant difference was observed for change in heart rate during the grip strength task.

Conclusions: A novel phybrata motion sensor objectively evaluating postural sway and standardized submaximal cardiovascular assessment evaluating symptom exacerbation demonstrated clinical utility in detecting physiological impairment within 7 days of an acute sport-related concussion.

A Retrospective Study of Shoulder Hydrodilatation Injection followed by Immediate Physiotherapy (Ship) for Frozen Shoulder. Does This Team Approach Improve Patients' Functional Outcomes and Pain Scores Compared With Usual Care?

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Objective: To compare outcomes for patients with diagnosed with frozen shoulder (FS) who received SHIP protocol to a group who received shoulder hydrodilatation + usual physiotherapy care (SHUC). We hypothesized that SHIP would lead to improved functional outcomes and pain scores at follow-up when compared with SHUC patients.

Study Design: Retrospective chart review capturing data from a Sport & Exercise Medicine clinic from May, 2018, to March, 2023

Participants: Adult patients diagnosed with "frozen shoulder" or "adhesive capsulitis" and who received SHIP or SHUC. Of identified records, 139 patient charts reviewed, 118 were included into the SHIP, and 21 in the SHUC groups and 19 charts had inadequate data recorded.

Intervention/Instrument (as applies): Ultrasound-guided hydrodilatation of the GH joint capsule by a volume of local anesthetic, normal saline with or without corticosteroid, followed by either immediate physical therapy (PTx) within 6 hours or usual care PTx at 7 to 14 days. All patients were seen in follow-up by their SEM physician at 4 to 8 weeks for evaluation of patient reported pain and function.

Outcome/Evaluation: Shoulder range of motion (ROM) measured in degrees, self-reported pain scores, and the Upper Extremity Functional Index (UEFI), at baseline and at follow-up SEM appointment.

Results: There were no significant differences between groups regarding age, gender, diabetes, or associated comorbidities ($P > 0.05$). At SEM follow-up, pain at rest scores was higher and observed ROM was less for the SHUC group; however, this was not statistically significant. The improvement in UEFI from preprocedure to the SEM follow-up for the SHIP group compared with the SHUC was statistically significant ($P < 0.05$).

Conclusions: These data suggest that SHIP protocol may be beneficial for improving UEFI with minimally important clinical difference and reducing patients shoulder pain due to FS. Owing to differences in clinicians' hydrodilatation procedure and lack of standardization in measuring ROM and pain at follow-up, more research is needed to determine the effectiveness of the SHIP protocol.

Acute and Chronic Injuries and Illnesses at the 2023 World Rowing Indoor Championships

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Objective: To determine the prevalence of injury and illness among competitors at the 2023 World Rowing Indoor Championships (WRICH 2023).

Study Design: Cross-sectional design.

Subjects: One hundred eighty participants (99 men, 76 women, 2 nonbinary, 3 unspecified).

Observation Technique: Four part, 97-item online survey on injury and illness experienced during and before WRICH 2023.

Outcome Measures: Our primary outcome measure was injury and illness rate. Secondary outcome measures included acute to chronic injury ratio, most common injury sites, and associations between training patterns and injury/illness rates.

Results: One hundred eighty competitors from 35 countries completed the survey (42% women, mean age 48 ± 17 years). Of the 180 participants, 79 (44%) experienced an injury in the four weeks before WRICH 2023. Sixty-three athletes reported 128 chronic injuries: 50 in the upper extremity, 50 in the lower extremity, and 28 in the trunk. Knee pain (18%) was the most common chronic injury reported, followed by low back pain (17%). Thirty-three athletes reported 43 acute injuries: 16 in the upper extremity, 15 in the lower extremity, and 12 in the trunk. The shoulder (23%) was the highest reported acute injury site. Most injuries occurred during ergometer training, followed by weight training. Eight participants suffered an injury while competing at WRICH 2023. Ninety athletes (50%) experienced 161 illnesses in the four weeks prior, the most common being general cold-like symptoms, experienced by 31 participants. There were no significant differences in training patterns or the experience level between injured and injury-free participants. Athletes who reported an illness also reported having significantly longer training sessions in the weeks leading up to the competition than those who did not ($P = 0.0474$).

Conclusions: This is the first study to describe the prevalence of injury and illness in indoor rowing athletes. Injuries and illnesses are common among international indoor rowing competitors. The rate of chronic injury was nearly twice the rate of acute injuries, and most athletes reported that their injuries occurred during ergometer training. Findings can provide direction toward the development of indoor rowing-specific injury and illness prevention strategies to optimize health and performance of indoor rowing athletes.

Patient-Level Risk Factors for Long-Term Opioid Pharmacotherapy Among Patients Undergoing Anterior Cruciate Ligament Reconstruction and Repair: A Retrospective Cohort Study

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Objective: Among patients undergoing anterior cruciate ligament (ACL) reconstruction and repair (ACLRR), we studied perioperative patient-level characteristics associated with likelihood of postoperative long-term opioid therapy (LTOT). We robustly defined LTOT. We also assessed the effect of initial postoperative opioid dispensation dosage and duration on eventual LTOT.

Study Design: Retrospective cohort using routinely collected administrative data.

Subjects: Patients undergoing ACLRR from January 2009 – March 2017 in Alberta, Canada.

Observation Technique: ACLRRs were indexed using physician billing codes. We linked available inpatient, ambulatory care, and pharmaceutical databases. Patient characteristics and opioid dispensation metrics were determined from 1 year preoperative to 1 year postoperative. Associations between patient-level risk factors and postoperative LTOT outcomes were described using multivariable logistic regression models. Models were generated for the whole ACLRR cohort, as well as for the subset of patients undergoing ACLRR who were both opioid-naïve and who received opioids within their first 30 postoperative days.

Outcome Measures: Three LTOT outcome measures: (1) >90 days' opioid supply during postoperative days 1 to 365, (2) at least three months with any opioid supply from postoperative months 3 to 12, and (3) at least 1 opioid dispensation between postoperative days 91 to 365.

Results: Among 15,675 ACLRRs, postoperative LTOT prevalence ranged from 1.9% (304 patients; LTOT definition 1) to 10.9% (1701 patients; LTOT definition 3). Preoperative opioid dispensation showed the strongest association with all LTOT outcome models (maximum OR 31.51; 95% CI 23.06-43.06). Other patient-level risk factors associated with increased LTOT included patient age older than 29 years, preoperative use of antidepressants, antipsychotics, or benzodiazepines; history of substance use disorder or uncomplicated diabetes; and ACL repair <14 days from injury versus ACL reconstruction. Among patients without preoperative opioid exposure, initiating postoperative opioid dispensations of ≥50 morphine milligram equivalent daily dosage and greater than 15-day duration were associated with increased LTOT.

Conclusions: We identified numerous patient-level factors associated with increased LTOT among patients undergoing ACLRR. Preoperative opioid use remained a chiefly important predictor.

Step it up to Level up: After ACL Reconstruction, do Individuals Reach Internationally Recommended Physical Activity Levels to Mitigate Risk of Post-Traumatic Osteoarthritis and How do These Levels Compare to Healthy Controls? A Systematic Review and Meta-Analysis

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Objective: We aimed to evaluate self-reported and objective/device-measured physical activity levels in individuals with anterior cruciate ligament reconstruction (ACLR) and compare them with international guidelines and to uninjured age-matched controls.

Study Design: Systematic review.

Data Sources: Seven databases (MEDLINE, Embase, Scopus, Google Scholar, Cochrane Library, Web of Science, and SPORTDiscus) were searched for case–control studies, cohort studies, cross-sectional studies, and randomized controlled trials (RCTs) that measured physical activity levels within 20 years after ACLR in minutes of moderate-to-vigorous physical activity (MVPA), step counts, or rates of energy expenditure. Data from RCT studies were included if collected at baseline or follow-up assessments in an observational group. Two reviewers conducted a title, abstract, and full-text review of eligible studies using predefined inclusion and exclusion criteria. Data were extracted, and quality assessments using the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) approach were performed.

Main Results: We found 15 studies involving 544 individuals with ACLR. Average physical activity levels for individuals with ACLR were 343 ± 185 MVPA min/week and 8453 ± 233 steps/day. In studies measuring the proportion of individuals with ACLR reaching MVPA guidelines, 147/213 (69%) achieved ≥150 min/week. Of those using step counts, 22/85 (26%) achieved ≥10,000 steps/day. Individuals with ACLR engaged in less physical activity than uninjured controls [SMD = −0.39 (95% CI = −0.61 to −0.17); $P < 0.001$]. The quality of evidence was low according to GRADE guidelines.

Conclusions: Individuals typically meet recommended MVPA, but not steps, after ACLR and engage in less physical activity than uninjured controls. Despite the lack of high-quality evidence, this review provides early evidence of a potential lack of mechanical loading within the first decade after ACLR. Steps per day may represent a modifiable prevention target and help guide the future development of tailored physical activity guidelines for PTOA prevention after ACLR. Optimal volume, type, and weight-bearing nature of physical activity after ACL should be investigated given the beneficial role of moderate mechanical loading in knee health.

The Association Between on-ice Skill Performance and Clinical Measures in Adolescent Ice Hockey Players

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Objective: To evaluate the association between on-ice skill performance and cervical spine, vestibulo-ocular reflex (VOR), dynamic balance, and divided attention outcomes in adolescent ice hockey players.

Study Design: Cross-sectional.

Subjects: Male and female adolescent ice hockey players (ages 10-17 years).

Observation Technique: Participants involved with a large community cohort study ("Safe2Play") completed a preseason baseline questionnaire, clinical assessments of cervical spine, VOR, dynamic balance, divided attention, and Transition Agility Skate with the puck (TAS) of the Hockey Canada Skills Test (HCST). Exposure variables included symptom reports (headache, dizziness, neck pain, visual disturbance; yes/no) and clinical outcomes: cervical spine [cervical flexor endurance (seconds), head perturbation test (/8), anterolateral strength (mean lbs; ratio of side to side imbalance), cervical flexion rotation test (CFRT) (positive/negative)], VOR [head thrust test (HTT) (unilateral or bilateral positive/negative), clinical dynamic visual acuity (logMar)], dynamic balance [Functional Gait Assessment (/30)], divided attention [Walking While Talking Test (WWTT) (seconds)].

Outcome Measures: The outcome was the TAS time (in seconds). A complete case mixed effects linear regression controlling for age group [U13 (ages 11-12), U15 (ages 13-14), U18 (ages 15-17)], sex (female/male), division (elite/subelite), player position (forward/defense/goaltender), and lifetime concussion history (yes/no), adjusting for cluster by team and individual, was completed to evaluate the association of clinical measures with TAS times.

Results: In total, 524 players (55 female; 10.5%) (563 player-seasons) performed baseline and all clinical measures. For every pound increase in anterolateral cervical strength (range: 2-30 pounds), players were 0.10 seconds faster (95% CI: 0.02-0.19). Based on point estimates, players with unilaterally positive CFRT (0.84 s; 95% CI: −0.07 to 1.74) or reported visual symptoms (1.22 s; 95% CI: −0.13 to 2.58) were slower, but these were not statistically significant. Relative to U13, U15 (2.20 s; 95% CI: 1.39-3.02) and U18 (3.54 s; 95% CI: 2.31-4.76) were significantly faster. Men averaged 2.71 s faster than women (95% CI: 1.64-3.79), as did players in elite divisions of play relative to subelite levels (2.63; 1.75-3.51). Goalies were 7.89 s (95% CI: 7.05-8.71) slower than forwards.

Conclusions: Cervical spine strength was associated with TAS performance in adolescent ice hockey players. A better understanding of the association between performance and clinical function will provide useful insights into targeted areas for performance training/rehabilitation.

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Novel Screening Protocol for Assessment of Hip Impingement in Adolescent Athletes: A Reliability Study

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Objective: To examine the intrarater and interrater reliability of a novel screening protocol aimed at identifying signs of hip impingement.

Study Design: Reliability study.

Participants: A convenience sample of 20 active adults (10 men, 10 women; ages 18-30 years) with no current lower body injury or history of hip surgery.

Observation Technique: Two raters (athletic therapists) completed a novel screening protocol designed to assess signs of hip impingement two. Participants completed all screening components twice with one rater. A third screening was completed with each participant with a second rater. The screening protocol included hip passive range of motion in degrees (PROM; straight and bent knee flexion, extension, internal and external rotation, abduction, adduction), power grading of each range tested passively (full power vs. power deficit), and special tests (binary, positive/negative: abduction-hyper-extension-external rotation, AB-HEER; anterior impingement test, AIMT; internal rotation over-pressure, IROP; flexion-adduction-internal rotation, FADIR; continuous measures, centimeters, cm: flexion-abduction-external rotation distance test, FDT; squat distance test, SDT).

Outcome Measures: Intraclass correlation coefficients (ICC) were used to examine intrarater and interrater reliability for all continuous outcome measures. Bland–Altman plots (mean difference and 95% limits of agreement – LOA) were used to examine intrarater and interrater agreement. Kappa coefficients and percent agreement were calculated for each binary variable.

Results: For intrarater reliability, passive extension of the right hip (degrees) had the lowest ICC (0.17; 95% CI: 0.01-0.83). Excluding this measure, ICCs ranged from 0.44 to 0.80 for PROM and 0.67 to 0.81 for continuous special tests (FDT/SDT; cm). Agreement ranged from 68% to 100% (kappa = 0.20-0.86) on binary special tests and 47% to 84% (kappa = −0.1 to 0.66) on power testing. For interrater reliability, PROM ICCs ranged from 0.50 to 0.91 between raters. ICCs for continuous special tests measured in centimeters (FDT/SDT) ranged from 0.66 to 0.76. Agreement on binary outcome special tests ranged from 65% to 100% (kappa = 0.26-0.76) and for power testing was 30% to 80% (kappa = −0.18 to 0.27). AIMT showed the lowest agreement in both intrarater and interrater testing (68.42%, kappa = 0.36; 65.00%, kappa = 0.26, respectively).

Conclusions: The screening protocol for examining hip impingement displays moderate-to-good reliability in examining range of motion and special tests in active patients aged 18 to 30 years. Clinician-performed power testing of all hip PROMs shows poor reliability. Reliability reported in this paper and previous studies indicate findings from clinical assessment of hip impingement should be cautiously considered between appointments and between clinicians.

Target Trial Emulation to Assess the Effect of Changing Load on Injury Risk in Adolescent Ice Hockey Players

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Objective: Target trial emulation is a framework for conducting causal inference using observational data. Our objective was to use this framework to estimate the intent-to-treat effect of changing load (measured using the acute:chronic workload ratio; ACWR) on injury risk among adolescent ice hockey players without recent injuries.

Study Design: Secondary analysis of data from a 5-year cohort study (2013-2018) including adolescent ice hockey players in Alberta and British Columbia. Data were collected on practice and game durations, absences, and hockey-related injuries for each player throughout each season.

Subjects: In total, 3226 hockey players ages 10 to 17 years [2957 men (91.7%), 269 women (8.3%)] contributing 162,675 player weeks. For a player week to be eligible for the target trial, the player must not have been injured in the previous 4 weeks.

Intervention: ACWR, with load measured as training duration (total minutes participating in games and practices). The acute load was the planned average daily training duration in the current week, while the chronic load was the average daily training duration over the previous 4 weeks.

Outcome Measures: Injuries occurring during the current week requiring medical attention or resulting in time loss. For target trial emulation, we identified eligible players and player weeks and modeled the relationship between ACWR and injury. We applied a nonlinear generalized additive model with generalized estimating equations to account for repeated measures. The potential outcomes for each player were estimated under different hypothetical interventions. We calculated injury risks under each intervention and risk ratios (RR) relative to maintaining load (ACWR = 1). We applied cluster bootstrapping to estimate 95% confidence intervals.

Results: There were 837 observed injuries. The point estimate for injury risk was 2.6% when everyone maintained their load (ACWR = 1) and increased modestly to 3.0%

(RR = 1.18, 95% CI: 0.89-1.88) for a 50% increase in load (ACWR = 1.5). Further increases in load resulted in slightly higher injury risks of 3.3% (RR = 1.28, 95% CI: 0.80-2.46) at ACWR = 2 and 3.5% (RR = 1.35, 95% CI: 0.65-2.86) at ACWR = 3. Decreases in load resulted in decreased injury risk, down to 1.7% at ACWR = 0.1 (RR = 0.65, 95% CI: 0.25-1.21).

Conclusions: Injury risk increases slightly for large increases in training duration among adolescent ice hockey players without recent injuries.