Athletic Therapy Students’ Perceptions of High-Fidelity Manikin Simulation: A Pilot Study

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Introduction: Traumatic events in the sports setting can result in devastating and life-threatening injuries. Currently, students in the Athletic Therapy program (BAHSc) at Sheridan College learn the necessary emergency skills to respond to such injuries through a variation of simulation models, with students portraying athletes and CPR manikins. Although this form of teaching is satisfactory in developing essential skills in students, it does not necessarily reinforce their ability to recognize or evaluate the most realistic physiological symptoms of injury.

Rationale: To evaluate whether athletic therapy students perceive the use of high-fidelity manikin simulation (HFMS) to be a superior tool for learning emergency skills, compared with student simulation (SS) in the laboratory setting.

Methods: Thirty participants from the BAHSc in years II and IV responded to the same emergency scenario using the SimMan3G (Laerdal Medical Canada, Toronto, Ontario, Canada) high-fidelity simulation manikin. Participants completed questionnaires for both the SS and HFMS environments that consisted of 16 specific learning needs (LN) that spanned the cognitive, psychomotor, and affective domains of learning. Questionnaires were used to help identify whether one environment was more successful than the other in achieving the LN for the students. Paired t tests were used to compare the LN responses for each environment.

Results: Participants reported all LN as being equally important in both environments, but HFMS was identified as the more optimal environment for achieving 13 of the 16 LN in a statistically significant manner (P < .05). All LN in the affective domain reached statistical significance (P < .05) in the HFMS environment, regardless of cohort. Year IV participants deemed HFMS to be a more effective means of learning in the cognitive and psychomotor domains, compared with year II students (P < .05).

Discussion: The HFMS experience enhanced athletic therapy students’ perceptions of their confidence, base of knowledge, decision-making skills, and overall acute management of critical life-saving situations. The greater significance reported by year IV students across all learning domains suggests that HFMS may have a greater impact when students’ levels of experiential learning are well established. Of particular interest is the success of using HFMS to address the learning needs in the affective domain, which include skills related to confidence, attitudes, values, and appreciations.

Importance: Athletic therapy students identified that HFMS is a more effective way of ensuring that their learning needs are not only met but also exceeded.

Central Adiposity and Low-Back Load During Lifting

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Introduction: Overload or repetitive mechanical load has been identified as a causal factor in low-back pathology. Although obesity, specifically central adiposity (CA), is associated with an elevated back pain risk, the extent that obesity impacts low-back loading has not been quantified.

Rationale: Knowledge of obesity biomechanics is required to understand back injury mechanisms and will aid in the design of injury prevention strategies. The objectives were to determine the effect of CA on trunk inertial parameters and low-back load during a sample of lifting tasks.

Methods: Body segment inertial parameters (mass, center of mass, inertia) were derived using a participant-specific photogrammetric approach for 5 individuals with CA (M = 34.5, SD = 4.0 kg/m²) and 3 height-matched participants with normal body mass indexes...
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(BMIs; M = 22.4, SD = 0.5 kg/m²). Mechanical load (torque and force) was estimated using an inverse dynamics approach for 3 conditions: (1) standing, (2) load carrying, and (3) lifting.

Results: Compared with the increase in whole body mass (M = 42.6, SE = 5.3%), CA was associated with significantly greater increases in trunk mass (M = 63.6, SE = 5.6%), trunk center of mass (M = 344.3, SE = 21.2% anterior), and trunk inertia (M = 107.5, SE = 8.3%), P < .05. Relative to normal BMI participants, torque about the low back was substantially elevated in CA for standing (M = 586.3, SE = 2.8%), carrying (53.4, SE = 4.5%), and lifting conditions (M = 48.9, SE = 16.5%), with absolute differences of +15.4 (0.6), +36.8 (1.1), and +128.9 (6.4) Nm, respectively (P < .01). The absolute magnitude (SD) of compressive force for the CA participants was estimated to be 821.8 (134.4), 2213.0 (213.1), and 5918.6 (634.1) Nm for standing, carrying, and lifting conditions, respectively.

Discussion: The increase in trunk inertial parameters associated with CA exceeded the change in whole body mass and was characterized by a substantial anterior shift in trunk center of mass, consistent with an accumulation of adipose tissue in the anterior abdomen. Both the relative (%) and absolute (Nm) effects of CA on low-back loading were also substantial but varied widely across conditions. The estimates of compressive force in CA participants greatly exceeded the recommended exposure limits for risk mitigation during lifting tasks.

Importance: The study provides estimates of trunk inertial parameters previously unavailable for a population at increased risk for back injury (CA) and demonstrates that individuals with CA will be exposed to even greater low-back loads than would be anticipated from body mass alone. These findings may explain a portion of CA-specific back injury risk and could be applied to injury prevention strategies.

Motion of the Anterior Cruciate Ligament During Internal and External Rotation of the Knee: A Preliminary Report

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Introduction: The anterior cruciate ligament (ACL) is the most frequently injured knee ligament. Advance-ments in ACL surgery have focused on reconstructing the ligament in a manner that replicates the anatomical position of the ligament’s 2 bundles: anteromedial (AM) and posterolateral (PL). To date, normal movement of the bundles of the ACL in the frontal plane during internal and external rotation of the knee has gone unreported.

Rationale: Normative data about ACL motion during internal and external rotation of the knee would assist surgeons in the development of more precise and effective surgical techniques. The purpose of this investigation was to quantify and compare the movements of the AM and PL bundles of the ACL during internal and external rotation, with and without anterior shear load. We hypothesized that there would be a significant difference in how the AM and PL bundles move during both internal and external rotation of the knee.

Methods: Twenty-four cadaveric knees (12 male and 12 female) were dissected and mounted in a position of 90° of knee flexion. Anthropometric data regarding the AM and PL bundles of the ACL were gathered, and each bundle was marked at the (1) femoral insertion; (2) midsubstance of ligament; and (3) tibial insertion. Digital images of ACL motion in the frontal plane were taken as the tibia was internally and externally rotated 15° about a fixed femur. Using a video analyzer program, the positional change of the ACL markers during rotation was quantified. Descriptive data were generated on ACL motion, and paired t tests were used to evaluate the statistical significance (P < .05) of changes in AM and PL bundle position during rotation.

Results: Data indicated that 15° of internal and external tibial rotation resulted in little movement of either bundle of the ACL in the frontal plane. When comparing internal and external rotation, motion of the markers (femoral/midsubstance/tibial) on each bundle of the ligament were similar. Data also indicated that a shear force of 20 lbs significantly altered the movement of the femoral attachment marker on the PL bundle.

Discussion: Our results are the first to quantify the motion of the 2 bundles of the ACL in the frontal plane during internal and external rotation of the knee.

Importance: This information should assist surgeons in determining more precise alignment and position of a graft when performing ACL reconstructive surgery and provide a positive impact on long-term outcomes associated with surgical intervention.
Effect of 15 Minutes of Passive Rest on SCAT3 Scores Following Maximal Aerobic Exercise

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Introduction: The Sport Concussion Assessment Tool, 3rd edition, (SCAT3) has been created to help assess the occurrence of a concussion in athletes. It is recommended that subjects rest for an arbitrary period of 10-15 minutes following injury to alleviate effects of fatigue prior to SCAT3 assessment. However, the exact amount of rest required for SCAT3 scores to return to baseline following exertion remains to be determined.

Rationale: To determine whether a 15-minute rest period following maximal aerobic exercise is an adequate amount of time for SCAT3 scores to return to baseline.

Methods: Twenty-six healthy, active volunteers participated. Each participant was assessed using the SCAT3 to obtain baseline measures, followed by a graded exercise test (GXT) to determine participants’ VO2max and ensure maximal exhaustion. Participants were then given 15 minutes of passive rest and were re-assessed using the SCAT3. Paired t tests were used to detect differences in SCAT3 scores, using a significance level of \( P < 0.05 \).

Results: The mean age, height, and mass of participants were 27.0 ± 4.0 years, 176 ± 11 cm, and 80.3 ± 14.0 kg, respectively. The number of symptoms increased from 1.7 ± 1.5 to 5.0 ± 3.6 during pre- and post-VO2max SCAT3 assessment, respectively (\( P < 0.05 \)). Symptom severity scores also increased from pre- to post-VO2max SCAT3 assessment (2.2 ± 2.1 versus 7.0 ± 5.2, respectively; \( P < 0.05 \)). Time to complete tandem gait decreased from pre- to post-VO2max assessment (14.9 ± 3.0 s versus 13.5 ± 3.4 s; \( P < 0.05 \)). No changes were observed for any of the other SCAT3 parameters.

Discussion: Our data suggest that 15 minutes of passive rest following maximal aerobic exercise may not be enough time to allow the number of symptoms and symptom severity scores to return to baseline in SCAT3 assessment. Although symptom scores are subjective, it remains possible that the observed differences may be due to the effects of exercise. Furthermore, the decrease in time to complete tandem gait post-VO2max indicates that this parameter may be sensitive to a training effect.

Importance: This study is one of the first to critically evaluate the newly implemented SCAT3 that many health practitioners use for concussion evaluation. With the findings that exercise may provoke signs and symptoms of concussion, our study provides novel evidence that a 15-minute rest period may not be adequate for SCAT3 parameters to return to baseline following maximal aerobic exercise.

Manipulation and Mobilization for Neck Pain: A Cochrane Systematic Review Update

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Introduction: Manipulation and mobilization are often used to treat neck pain.

Rationale: To update a systematic review on randomized controlled trials (RCTs) assessing whether manipulation and mobilization versus control improves pain, function and disability, and quality of life in adults with acute, subacute, and chronic neck pain, with or without cervicogenic headache or radicular findings.

Methods: A computerized search was conducted up to March 2013 for RCTs on manipulation or mobilizations. The 2 authors independently selected studies and abstracted data and clinical applicability, determined grade, and assessed risk of bias. Pooled relative risk and standardized mean differences (SMD) were calculated.

Results: We included 20 studies (973 participants). Twelve studies had low risk of bias. Cervical manipulation: For subacute and chronic neck pain, there is low and very low quality evidence (8 trials, 297 participants) that a single manipulation produces pain relief at immediate but not short-term follow-up and reduced tenderness in both the immediate and short term. However, there is conflicting evidence for multiple sessions at short-term follow-up for pain reduction. Thoracic manipulation: Three trials (150 participants) using a single session of manipulation were assessed, very low to low quality evidence showed varied results for pain reduction but favored manipulation for function. Seven trials (428 participants) using multiple sessions of manipulation for acute to chronic neck pain were assessed at 3 time intervals. At short-term follow-up, moderate quality evidence favored manipulation in pain reduction.
for patients with acute and subacute neck pain (5 trials, 346 participants, pooled SMD: –1.26[–1.86, –0.66]) and with acute to chronic neck pain it improved function (4 trials, 258 participants, pooled SMD: –1.40[–2.24, –0.55]). These findings were consistent at intermediate follow-up for pain, function, and quality of life (low quality evidence, 1 trial, 111 participants). The funnel plots suggest publication bias. Mobilization: Two trials (57 participants) with very low to low quality evidence reported no additional pain relief when mobilization was used. They were clinically heterogeneous due to disorder type and frequency of intervention.

Discussion and Importance: Continued research is needed to determine whether manipulation and mobilization of the spine can improve neck pain, function, and quality of life.

Literature Review of the Discriminative and Evaluative Properties of Health Status Assessment Tools for Patients Presenting With Shoulder Disorders
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Introduction: Patient-reported outcome measures (PROM) can be used to measure health status. PROM can be discriminative and/or evaluative. The goal of a discriminative instrument is to detect differences between subjects at a single point in time. The goal of an evaluative instrument is to detect longitudinal change within subjects. The aim of this review was to summarize the discriminative and/or evaluative properties of PROM instruments for patients presenting with shoulder disorders.

Rationale: The goal of this study is to identify the most appropriate and clinically meaningful health status index tool for patients presenting to an interdisciplinary Shoulder Injury Clinic.

Methods: A review of the literature was conducted. Abstracts were reviewed and only full-text articles were selected based on the following inclusion criteria: must have PROM, be specific to shoulder disorders or disabilities and written in English, and discuss reliability, validity, and/or responsiveness of the instrument.

Results: The review identified 23 potential assessment tools: 5 generic and 18 disease-specific (DS) assessment tools. All 5 generic tools measured health-related quality of life (HRQL). DS tools assessed a range of constructs including physical, emotional, social, and functional status. The majority of DS tools were directed at patients with general shoulder disorders. One tool was specific to patients presenting with rotator cuff disorders. One tool was specific to patients presenting with osteoarthritis. One tool was specific to disorders of the upper extremity (ie, arm, shoulder, and hand). Overall, the Disabilities of the Arm, Shoulder, and Hand (DASH) outcome measure was found to be both discriminative and evaluative.

Discussion: Generic tools were useful in monitoring the effect of shoulder dysfunction on general health, but concerns about the sensitivity of the generics and their relevance for some conditions still remain. DS tools were more responsive in their ability to detect clinically meaningful differences but did not reflect HRQL well. The DASH is an instrument that possesses sound psychometric and clinimetric properties and would be appropriate for patients presenting with shoulder injuries to an interdisciplinary Shoulder Injury Clinic.

Importance: Shoulder dysfunction is responsible for approximately 16% of all musculoskeletal complaints, with a growing incidence of new patients seen in the primary care setting annually. Future clinical care pathways that utilize interdisciplinary teams must employ a PROM to measure their success relative to existing clinical care pathways. Using a PROM that is evaluative and discriminative is important for all aspects of patient comparisons.

History of the Scanning Examination: Implications for Future Teaching and Research
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Introduction: The scanning examination is an important component in the overall orthopedic/musculoskeletal (MSK) evaluation of patients for athletic therapists in Canada. However, little research has been published on the topic. The origins and evolution of a scanning examination are not clear.
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Heart Rate Variability Pre- and Postconcussion: A Pilot Study
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Objective: This study aimed to collect pilot data to evaluate heart rate variability (HRV) before and after concussion in an attempt to identify its use as an objective assessment tool.

Rationale: The incidence and recognition of sport related concussion has shown that improved assessment methods are needed. Studies have shown that current assessment methods lack objectivity and sensitivity, limiting the usefulness of such a measure to identify concussion.

Design: This descriptive pilot study compared baseline and postconcussion scores following sport-related concussion.

Participants: Four female varsity athletes with baseline heart rate variability data were reassessed following concussion (mean age = 19.25 ± 1.5 years; mean time since injury = 83.5 ± 53.2 days).

Methods: Heart rate variability was obtained during 5 minutes of supine rest.

Outcome Measures: Frequency domain measures of high frequency (HF), total power and low frequency (LF) were examined.

Results: Three of 4 participants displayed impaired HF, total power, and LF on day 1 postconcussion when compared with preinjury baseline results. One participant who was not tested until day 3 postinjury displayed an increase in all HRV measures compared with baseline.

Conclusions: HRV may have the potential to be used as an objective measure to indicate concussion in the acute phase (1 to 2 days postconcussion). Total power HRV may be a potential indicator of severity.

Assessment of Muscle Activity and Kinematics During a Controlled Descent on Outstretched Arms in Young Women
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Introduction: During a fall, landing on outstretched hands is a common response to arrest the body and avoid injury to the head or body. Falls on the out-
stretched hand (FOOSH) account for 90% of falls in young adults, and women are 4 to 6 times more likely than men to fracture their wrist as a result of a FOOSH. Strategies such as neuromuscular training may be effective in reducing the risk of injury during a fall.

**Rationale:** A key to developing FOOSH injury reduction intervention strategies is understanding muscle function during a FOOSH. The purpose of this study was to examine the relationships between upper body muscle activity and increasing physical demand during a controlled FOOSH-like descent in young women.

**Methods:** Twenty healthy female participants (mean age = 24.8 years) performed controlled descents on outstretched arms. The physical demands of the descents were varied by having participants descend at three different body lean angles (60°, 45°, and 30°) and slow and fast speeds. Each participant performed 3 descents at both speeds at each angle with rest periods between trials. Muscle activations were collected using surface electromyography (EMG), and kinematics were measured using a 3-dimensional motion capture system. The descent phase of each trial was identified using elbow joint flexion, and mean EMG activations over the descent were calculated as a percentage of maximum voluntary activation levels obtained prior to the testing.

**Results:** A 2-way repeated measures ANOVA was used to test the effect of body lean angle and speed of descent on the mean EMG activation in 6 muscles: triceps long head (TL), internal oblique (IO), external oblique (EO), biceps brachii (BB), anterior deltoid (AD), and pectoralis major (PM). There was a significant main effect (\( P < .05 \)) for body angle for all muscle activations and for speed for all muscle activations except the triceps. For both conditions, muscle activation increased with increasing descent difficulty. Further analysis showed that the EO and PM muscles had the greatest percent change as the level of difficulty increased.

**Discussion:** The results indicate that the EO and PM muscles may play an important role in minimizing injury risk during a FOOSH.

**Importance:** The results of this study will help in identifying the primary muscles used for arresting a FOOSH. The data indicate that incorporating core muscle stability training may be beneficial to include in fall prevention training program.

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