PURPOSE: 1) to examine the effect of suspension training on functional movement, assessed via the FMS and MAPS and 2) to identify the correlation between the FMS and MAPS.

METHODS: Twenty-seven participants (19 females; 8 males; Age = 26.0 ± 11.1 yrs; Height = 167.9 ± 9.1 cm; Body Mass = 69.6 ± 14.1 kg) completed 28 exercise sessions over a 14-week course. Throughout each 40-minute exercise session, six body positions were utilized on the suspension training straps which included push, pull, rotational, squat, and lunge movements; participants also engaged in functional training utilizing stability balls and resistance bands. Pre- and post-assessments included the FMS, MAPS, body composition, muscular endurance, muscular strength, and flexibility. Independent t-tests were determined to determine if there were mean changes in functional movement status. Due to multiple comparisons, Bonferroni correction was used, therefore, alpha level was set at .007.

RESULTS: There were significant positive changes in FMS (14.6 ± 2.7 to 15.9 ± 2.1, p<0.001) and MAPS (52.9 ± 10.3 to 56.3 ± 9.7, p<0.001) values, as well as mean quantity of push-ups (24.9 ± 11.5 to 29.4 ± 13.9, p<0.004) and handgrip dynamometer (78.0 ± 21.7 kg to 85.6 ± 24.0 kg, p=0.006). There were no significant changes in mean body mass, fat mass, lean mass, percent body fat, and sit-and-reach values. Pearson correlation was used to determine the relationship between FMS and MAPS both at pre- and post-testing. At both time points, pre- and post-testing, the correlations were significant (r=.52 and .43, respectively).

CONCLUSIONS: Participation in suspension training produced significant improvements in overall functional movement, muscular strength, and endurance. Although there were significant positive changes in both FMS and MAPS from pre- to post-assessment, a weak correlation existed between the FMS and MAPS assessments.

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**Board #197**
**June 1 8:00 AM - 9:30 AM**
**Biomechanical Analysis of Collegiate Baseball: Training Implications for Enhancement of Pitching Endurance**
Andrea M. Maitoza, William P. Lydon, J. Mark VanNess, Alexis C. King, Courtney D. Jensen. University of the Pacific, Stockton, CA. University of Illinois at Urbana-Champaign, Champaign, IL.

(No relationships reported)

Endurance is critical to a starting pitcher’s success. However, the repetition of pitching stress can decrease performance and increase risk of injury in later innings. Improving arm endurance likely enhances late-game performance.

PURPOSE: To evaluate predictors of mechanical endurance in collegiate pitchers.

METHODS: 10 Division I pitchers were tested using Proteus technology (Boston Bioquestion, Inc.). They completed 6 sets of 5 pitches; each set changed in resistance, ranging from ½ to 5 lbs. Endurance was a calculation of the ability to preserve power in each set on a continuous scale of 0.00 (0% preservation) to 1.00 (100% preservation). Mean endurance was the mean value of all 6 sets. Proteus also assessed biceps curls, triceps extensions, internal and external rotation, and horizontal adduction and abduction. Pitchers were tested during the 2017 season and data were compared to in-game performances. Linear regressions tested the relationships between endurance, performance on other tests, and in-game statistics.

RESULTS: Pitchers were 27.0 ± 2.7 inches in height, had a mean fastball velocity of 84.6 ± 3.9 mph, a mean earned run average (ERA) of 5.8 ± 2.8, and a mean endurance of 97.7 ± 1.9%. Endurance was unrelated to class year (p=0.857) and was not related to anthropometric measurements, including height (p=0.460), weight (p=.188), arm length (p=0.350), and leg length (p=0.484). Maximum squat strength (p=0.917), fastball velocity (p=0.832), and three-dimensional measurement of pitch range of motion (p=0.730) were also unrelated to pitch endurance. Biceps curl endurance (p=0.035) and triceps extension explosiveness (p=0.089) of the dominant arm correlated with pitching endurance (p<0.05). With a 60 frame filter, the model detected 20 false positives. With a 30 frame filter, the model detected all 32 validated impacts with high success but with many false positives. The high false positive rate presents a challenge, but since a large proportion of false positives were simple pass-bys, using a real-time sensor fusion approach with WS, the false positives may be reduced substantially.

CONCLUSIONS: Fatigue results from repetitive overhead throwing, elevating risk of overuse injuries. Use of Proteus may provide modes of exercise unrecognized by traditional baseball training.

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**Board #198**
**June 1 8:00 AM - 9:30 AM**
**Automated Impact Corroboration From Game Video In Ice-hockey Using Computer Vision Approaches**
Muhammad Sohaib Arif, Aaron Pilotti-Riley, Erik Bolli, Stephen J. McGregor, Davor Stojanov. Eastern Michigan University, Ypsilanti, MI. Clarkson University, Postdam, NY. (Sponsor: Mark Peterson, FACSM)

Email: mariif@emich.edu

(No relationships reported)

PURPOSE: Video corroboration of on-ice impacts identified by wearable sensors (WS) is a time-consuming task. To automate this, we attempted a computer vision approach to record game video to corroborate impacts identified using WS among national ice-hockey team members.

METHODS: 23 U.S. National U18 Hockey team members consented to be a part of the study. Impacts were previously validated from data collected at 100 Hz (Impact Processor, Zephyr MD) from 8 players with the top activity levels determined by WS in 4 games. Game video was manually synchronized, and timestamps were used to extract frames from the video that were used as training data. Convolutional neural network (YOLO) was used to detect impacts in video and generate a training dataset from 1060 images of 3 game videos that included 86 impacts.

RESULTS: The trained YOLO model was used to detect impacts by video and create a training dataset from 1060 images of 3 game videos that included 86 impacts. Video and timestamps were used to train the model on training data and fine-tune the model. Denoising filters were used to account for time shift errors due to manual labeling and abnormal detections appearing and disappearing in up to half a second of video. Thus, we removed any impacts detected by video for less than 30 or 60 continuous frames (0.5 or 1.0 second, respectively). An average size of each region was 150 pixels. The trained model detected 20 of the 32 events, but false positives were reduced to 211. With a 30 frame filter, the model detected all 32 impacts but false positives increased to 391. Interestingly, the mobile model and 30 frame filter detected 32 impacts with 222 false positives, of which 99 were classified as “Pass Bys” or players that occluded each other on the video but did not make physical contact.

CONCLUSION: These results demonstrate that computer vision techniques can be used to identify validated impacts with high success, but with many false positives. The high false positive rate presents a challenge, but since a large proportion of false positives were simple pass-bys, using a real-time sensor fusion approach with WS, the false positives may be reduced substantially.

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**Board #199**
**June 1 8:00 AM - 9:30 AM**
**Relationship Between the Perceived Training Loads of Division II Swimmers and Coaches**
Bianca Lagamon, Angel Quintero, Derrick Gardner, Vanessa Yingling, FACSM, James Mouat IV. California State University, East Bay, Hayward, CA. (Sponsor: Vanessa Yingling, FACSM)

(No relationships reported)

Monitoring training loads provides coaches the opportunity to create effective programs for their athletes to prepare for competition and make adjustments to manage fatigue, reduce the risk of soft-tissue injuries and non-functional overreaching. An athlete’s training load is a combination of the external load (work completed by the athlete) and internal load (physiological or psychological).

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