**METHODS:** Twelve recreationally trained subjects (six males, six females; age: 23 ± 0.5 years, height: 182 ± 3.2 cm, body mass: 74 ± 6.1kg, DL 1-RM: 128 ± 53.6kg, SDL 1-RM: 127 ± 56.8 kg, SLDL 1-RM: 117 ± 49.6 kg) participated in this within-subject crossover design. Electromyographic (EMG), activity of the DL, SDL, and SLDL for the vastus lateralis (VL), vastus medialis (VM), biceps femoris (BF), medial hamstring group (MH), and erector spinae (ES) was measured. Gender differences were evaluated, comparing the difference in the H:Q ratio between male and female. For the second session, participants completed three repetitions at 80% of their 1RM for each lift as EMG data was collected. Raw EMG data was smoothed and rectified with NORAXON software (150 Hz) and mean peak activation was expressed as the root mean square (RMS). EMG values obtained during the 3 repetition experimental session were averaged then normalized to the EMG values achieved in the 1RM.
**RESULTS:** Results showed no significant differences ($p>0.05$) in normalized EMG values between the five measured muscles during the DL, SDL and SLDL. No significant difference ($p > 0.05$) was found in HQ ratios between males to females; however, there was a statistical trend in the SLDL that indicated sex differences in the HQ ratio, with males having the higher HQ ratio ($p=0.063$).
**CONCLUSIONS:** This study revealed that no variation is superior in activating the quadriceps, hamstrings, or low back, indicating all three variations are acceptable methods to train the aforementioned musculature. Moreover, the lack of significant disparity between males and females suggests women are not quadriceps-dominant and display similar activation patterns to males.

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**2573** Board #34 May 29 9:30 AM - 11:00 AM

### The Effect Of Concentric Prime Movers Vs. Synergist Muscle Contraction On Coactivation Ratios

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**PURPOSE:** The purpose of this study was to examine the coactivation ratio of agonist to antagonist muscle groups with varying pre-exhaustion protocols, and to see if postactivation potentiation is influenced by pre-exhaustion.
**METHODS:** Eight college age males and females were recruited for the study. Each participant visited the Human Performance Laboratory four times over the duration of the study. Subjects were monitored via EMG and randomly performed 1 set of 50 repetitions maximal voluntary knee extension, knee flexion, and knee extension/flexion at $60°\cdot s^{-1}$ using an isokinetic machine on the dominant leg. They performed 1 set of 10 repetitions of modified Peterson step-up testing at pre-exercise, immediately post-exercise, and seven (7) min following exercise.
**RESULTS:** The 50 repetitions of isokinetic knee extension, flexion, extension/flexion at $60\cdot s^{-1}$resulted in a significant drop in peak torque in all groups ($P<0.01$). Pre-exhausting the agonist muscle group prior to Pearson step-up improved agonist skeletal muscle motor unit recruitment ($P<0.05$). Pre-exhausting the antagonist muscle group with flexion and combination prior to Pearson step-up did not have any effect on agonist skeletal muscle motor unit recruitment. Pre-exhausting the agonist muscle group down-regulated antagonist muscle activity. Coactivation improved only by fatiguing the agonist muscle group. Postactivation potentiation was only affected by fatiguing the agonist muscle group ($P<0.05$).
**CONCLUSIONS:** We conclude that pre-exhausting the agonist muscle group might be beneficial for improving muscle activity in functional rehabilitation exercises and during the period of recovery. Given the small number of subjects in this study, additional research using larger subject groups and different fatiguing and post-activation protocols is warranted to support the use of pre-exhaustion techniques to improve activity/recruitment of atrophied muscle in physical therapy settings.

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**2574** Board #35 May 29 9:30 AM - 11:00 AM

### Electromyographic Analysis Of Steel Mace Exercises: A Descriptive Study Of Alternative Training Modalities

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Alternative training modalities (ATM) have recently gained popularity as a form of resistance exercise through non-traditional methods and equipment. ATM share a common characteristic, the incorporation of non-traditional exercise movements and equipment in efforts to develop strength in a multi-planar fashion. Forms of common ATM include kettlebells, battle ropes, tires, and the steel mace. The steel mace, like a sledgehammer, consists of a long-levered club attached with a heavy sphere (i.e. mace head) fixed at one end. What remains relatively unknown are the neuromuscular demands of specific muscles or muscle groups among steel mace exercises.
**PURPOSE:** To examine the electromyographic profile of four common steel mace exercises: the overhead squat, 360° overhead rotation, reverse lunge offset, and lap offset squat.
**METHODS:** Twenty-nine resistance-trained males ($n=15$) and females ($n=14$) were recruited to participate in this cross-over experimental design investigation. All participants completed each of the four exercises with the mace head (i.e. heavy sphere) on both dominant and non-dominant sides of the body. Normalized surface electromyography (EMG) of the dominant-side upper trapezius, anterior deltoid, pectoralis major, triceps brachii, biceps brachii, external oblique, rectus femoris, and biceps femoris were analyzed. A one-way ANOVA was used to compare normalized EMG among muscles within each exercise and among exercises for each muscle.
**RESULTS:** As a summary of major findings, for each exercise and muscle group, EMG activity was significantly altered when positioning the mace head ipsilateral vs. contralateral to the dominant side ($p<0.05$). Additionally, each exercise demonstrated differential EMG activities among muscle groups ($p<0.05$). Overall, the upper trapezius and rectus femoris exhibited the greatest EMG activity ($p<0.05$). All muscle groups except for the biceps brachii and external oblique showed differential EMG activity among exercises ($p<0.05$).
**CONCLUSIONS:** The present findings provide practically significant information regarding the muscle-specific demands of popular steel mace exercises which may provide valuable insight for athletes, fitness enthusiasts, and exercise practitioners who implement steel mace training programs.

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**2575** Board #36 May 29 9:30 AM - 11:00 AM

### Inter-Repetition Rest Interval Affects Peak Power Independent Of Its Rate Of Development

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Numerous variables influence performance in resistance training. The duration between sets has been explored both for its acute effect on the subsequent set as well as its effect on the physiological responses to exercise. However, the duration of rest between repetitions is relatively unexplored.
**PURPOSE:** To evaluate the effect of inter-repetition rest interval (IRRI) duration on power parameters within a single set.
**METHODS:** We tested 206 healthy men and women between the ages of 15 and 70 using Proteus technology (Proteus Motion, USA). Subjects performed 36,728 repetitions across 4,566 sets of 25 exercises at various loads (1lb to 25lb) of three-dimensional isotonic resistance. Proteus software calculated the IRRI duration (milliseconds) and each repetition's peak power (watts) and peak force development rate (watts/sec). Linear regression models tested the effect of IRRI duration on the peak power and peak force development rate of the subsequent repetition while controlling for other significant predictors.
**RESULTS:** In upper body motions, holding constant exercise performed ($p<0.001$), resistance applied ($p<0.001$), and repetition number ($p=0.045$), each additional second of IRRI predicted a 2.23-watt increase of peak power in the next repetition ($p<0.001$; 95% CI: 1.81-2.65). The overall model was significant ($R^2=0.613$; $p<0.001$). Lower limb motions displayed a similar pattern ($R^2=0.620$; $p<0.001$) but the magnitude of effect by IRRI duration was smaller ($p=0.001$; $\beta=1.13$; 95% CI:0.67-1.59). Lower limb peak force development rate was unaffected by IRRI ($p=0.714$); in upper body motions, there was a weak negative trend ($\beta=-2.08$; $p=0.090$). At loads under 20lb, IRRI was less influential to performance; for loads of 20-25lb, the optimal IRRI duration was 2.50-3.00 seconds. Holding confounders constant, repetitions that followed this duration of IRRI experienced a 40.99-watt increase in power ($p<0.001$; 95% CI: 17.76-64.22). That duration had no effect on peak force development rate ($p=0.443$).

**CONCLUSIONS:** Performance in resistance training is affected by innumerable factors. Our findings add one more for consideration: the duration of rest between repetitions within a single set. To achieve maximum power in the subsequent repetition, a rest interval of 2.50 to 3.00 seconds appears ideal.

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**2576** Board #37 May 29 9:30 AM - 11:00 AM

### Evaluation Of Stretch Shortening Cycle Performance Of Upper Limbs

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**PURPOSE:** The purpose of this study was to suggest an indicator for the Rebound Jump-index (RJ-index) of upper limbs that reflects the Stretch-Shortening Cycle performance (SSC performance) of the upper limbs, and elucidate the inter-trial reliability and the criterion-related validity of this indicator.
**METHODS:** The subjects were 31 male university track-and-field athletes between the ages of 18 and 21 years. Using an optical sensor, five rebound jumps with the upper limbs were performed on-site, and a jump height derived from the ground contact time and airborne time was calculated. The jump height was further divided by the ground contact time, and treated as the RJ-index of the upper limbs. For the rebound jumps, we instructed the subjects to keep their elbows as straight as possible during ground contact, keep the ground contract time short, and jump high. At the start of measurement, the hip joint angle was fixed to be 0°, and both upper limbs were kept perpendicular to the floor. In order to verify the reproducibility (inter-trial reliability) of the RJ-index measurement values of the upper limbs, we performed the same measurements 2 weeks later and derived the intraclass correlation coefficients (ICC) between the measurement values. In addition, To assess the criterion-related validity of the RJ-index of the upper limbs, we performed to the correlation between the RJ-index measurement and the shot put records.
**RESULTS:** ICC (1,1) between the RJ-index measurement of upper limbs (0.19+0.07) and the re-measurement (0.18+0.08) was $\rho$=0.83, and ICC (1,2) was $\rho$=0.91. These values indicate that the measurement reproducibility was relatively high. Upon deriving the partial correlation coefficient assuming age and weight as control variables, a relatively high correlation was seen between the RJ-index of the upper limbs and the shot put records ($r$=0.59, $p$<0.01).
**CONCLUSIONS:** Therefore, we think that it is apparent that the RJ-index of the upper limbs had a definite inter-trial reliability and this test may possibly have criterion-related validity as an assessment test for SCC performance of the upper limbs.

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**2577** Board #38 May 29 9:30 AM - 11:00 AM

### Muscular Excitation Is Not Greater During Conventional Arm Care Exercises Than During Overarm Throwing

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*(No relationships reported)*

Conventional arm care exercises include the use of rubber tubing (Jaeger Bands) and soft weighted balls (Plyocare Balls). It is postulated that these training devices may be used to prepare the arm for the forces present during overarm throwing. However, little research exists on the physiological effect of conventional arm care exercises.
**PURPOSE:** To test the hypothesis that muscular excitation is greater during conventional arm care exercises than overarm throwing.
**METHODS:** Nineteen males (age: 21 y, BMI: 26.6 kg/m$^2$) participated in this investigation. Two independent wireless surface electromyography (sEMG) devices (Somaxis Cricket) were used to asses muscular excitation of the shoulder (SH) and the forearm (FA). Following a standardized warm-up, maximal voluntary isometric contractions (MVIC) of the SH and FA were measured. Each visit consisted of various Jaeger Band Exercises targeting SH rotation and Plyocare Ball Exercises targeting arm force absorption. The arm care exercises were compared to overarm throwing via a one-way ANOVA and a Pearson correlation. Data are presented as a percentage (%) of MVIC (mean±SD).
**RESULTS:** Peak sEMG amplitude of the SH was not significantly different for Jaeger Band External Rotation (45±22%, p=0.91), Reverse Throw Green (55±21%, p>0.99), and Rebounders Black (41±16%, p=0.35) when compared to overarm throwing (56±21%). Peak sEMG amplitude of the FA was not significantly different for Jaeger Bands External Rotation (45±31%, p=0.06), Reverse Throw Green (57±22%, p=0.46), and Rebounders Black (72±22%, p>0.99) when compared to overarm throwing (72±17%). For the SH, Jaeger Bands External Rotation (r=-0.18, p=0.24), Reverse Throw Green (r=-0.03, p=0.46), and Rebounders Black (r=0.16, p=0.27) were not significantly correlated with overarm throwing. For the FA, Jager Bands External Rotation (r=0.43, p=0.04) was significantly correlated, while reverse Throw Green (r=0.15, p=0.27) and Rebounders (r=0.39, p=0.06) were not significantly correlated with overarm throwing.
**CONCLUSION:** These data indicate that conventional arm care exercises do not generate greater muscular excitation than overarm throwing. Therefore, it does not appear that these arm care exercises adequately prepare the arm to throw at high velocities.

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**2578** Board #39 May 29 9:30 AM - 11:00 AM

### Overspeed Exercises Of The Arm Produces Greater Muscular Excitation Than An Overarm Throw

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*(No relationships reported)*

Overspeed (OS) training is used to train the body at speeds that are faster than regular competitive speeds. To this end, OS training enhances muscular rate coding, which leads to muscular adaptation. Recently, OS training of the legs with resistance bands was shown to increase vertical jump height in trained males. However, little is known about OS training of the arm as it relates to an overarm throw.
**PURPOSE:** To test the hypothesis that muscular excitation of the arm is greater during OS training than an overarm throw.
**METHODS:** Nineteen males (age: 21 y, BMI: 26.6 kg/m$^2$) completed four visits to the laboratory. Muscular excitation of the anterior forearm (FA) and posterior shoulder (SH) were assessed using two independent wireless surface electromyography (sEMG) devices (Somaxis Cricket). Maximal voluntary isometric contractions (MVIC) of the FA and SH were assessed after a standardized warm-up. Each visit consisted of various band assisted OS exercises. In general, the subject placed their arm between a stretched resistance band and moved their arm at maximum intent for ~six seconds. The position of the body was dependent upon the exercise and the amount of weight in the hand varied. The exercises were compared to an overarm throw via a one-way ANOVA and a Pearson correlation. Data are presented as a percentage (%) of MVIC (mean±SD).
**RESULTS:** Peak sEMG amplitude of the FA was significantly greater for the OS Unweighted Shoulder Y (110±33%, p=0.01) and the OS Weighted Drop Shoulder Y (95±27%, p=0.01) when compared to the overarm throw (72±17%). Peak sEMG amplitude of the SH was significantly greater for the OS Unweighted Shoulder Y (82±29%, p=0.03) when compared to an overarm throw (56±21%). Peak sEMG amplitude of the SH was not significantly different for the OS Weighted Drop Shoulder Y (65±21%, p=0.39) than the overarm throw. For the FA, OS Unweighted Shoulder Y (r=0.57, p<0.01) and OS Weighted Drop Shoulder Y (r=0.72, p<0.01) were significantly correlated with overarm throwing. For the SH, OS Unweighted Shoulder Y (r=0.52, p=0.01) and OS Weighted Drop Shoulder Y (r=0.77, p<0.01) were significantly correlated with overarm throwing.
**CONCLUSION:** These data indicate that OS training generates greater peak sEMG amplitude than an overarm throw. Yet, it remains unclear whether OS training will enhance throwing velocity.

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**2579** Board #40 May 29 9:30 AM - 11:00 AM

### Differences In Quadriceps Muscle Endurance Between Healthy Males And Females

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