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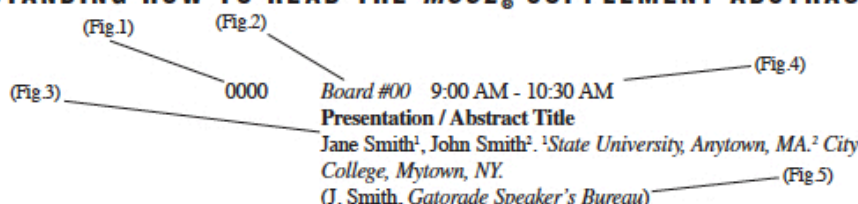
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2012 Annual Meeting–World Congress on Exercise is Medicine® Abstracts

May 2012

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- A = Tuesday/Wednesday morning
- B = Wednesday afternoon
- C = Thursday morning
- D = Thursday afternoon
- E = Friday morning
- F = Friday afternoon
- G = Saturday morning

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playing time was obtained from the coaches. ANOVA was used for comparisons of characteristics by playing position. Significance was set at  $p < 0.05$ .

**RESULTS:** The following trends (means) were noted in sequence among defenders, midfielders and forwards, respectively: CA (12.1, 11.7, 11.9 yrs,  $p=0.003$ ); SA (12.8, 12.1, 11.6 yrs,  $p=0.060$ ); SA-CA (0.71, 0.40, -0.31 yrs,  $p=0.256$ ); height (151.5, 144.2, 142.6 cm;  $p=0.098$ ); weight (46.3, 35.7, 35.1 kg,  $p=0.056$ ); peak oxygen uptake (2.66, 2.21, 2.18 L/min;  $p=0.048$ ); training volume (7053.3, 6283.6, 6322.5 min,  $p=0.790$ ); played time (712.8, 535.9, 433.4 min,  $p=0.021$ ).

**CONCLUSION:** Under-12 soccer players are reasonably differentiated in size, maturity, aerobic fitness and training/playing time by position, especially defenders compared to forwards and midfielders. Longitudinal studies are needed to examine developmental changes and eventual career success of young soccer players specialized in different positions at relatively early ages.

Partially supported by FCT Grant SFRH/BD/69447/2010

91 Board #6 May 29, 9:30 AM - 11:30 AM

#### Reliability of Hip and Knee Isometric Strength Testing in Young Athletes

Joanne L. Parsons, Michelle M. Porter. *University of Manitoba, Winnipeg, MB, Canada.*  
(No relationships reported)

The ability to quantify lower extremity neuromuscular strength in young athletes may aid in identifying deficiencies that increase the risk of knee injury. However, the outcome measure must be reliable in order for interventions to be appropriately assessed.

**PURPOSE:** To determine the relative and absolute test-retest reliability of hip abduction/adduction and hip and knee flexion/extension isometric average (AT) and peak torque (PT) using an isokinetic dynamometer in athletes aged 10-14 years.

**METHODS:** Fifty-two athletes (26 girls) were tested twice about one week apart ( $T_1$  &  $T_2$ ). Hip strength was tested in standing and knee strength in sitting. Relative reliability was assessed using intraclass correlation coefficients (ICCs), and absolute reliability was assessed using standard errors of measurement (SEM), coefficients of variation of the typical error ( $CV_{TE}$ ) and ratio limits of agreement (RLOA).

**RESULTS:** Relative reliability was similar for AT (ICCs=0.8-0.97) and PT (ICCs=0.79-0.97) for all muscle groups. Paired t-tests identified systematic bias in some measures (hip adduction PT at  $T_1=45.4$  vs.  $T_2=50.5$  Nm; hip adduction AT at  $T_1=38.7$  vs.  $T_2=43.1$  Nm; knee extension AT at  $T_1=86.0$  vs.  $T_2=82.5$  Nm;  $p < 0.05$ ). Hip flexion and knee extension PT and AT demonstrated better absolute reliability (PT SEM=8.1 & 8.7 Nm,  $CV_{TE}=9.3$  & 12.9%; AT SEM=6.8 & 8.5 Nm,  $CV_{TE}=12.6$  & 10.1%) compared to the other muscle groups (PT SEM=10.3-14.3 Nm;  $CV_{TE}=24.1$ -27.0%; AT SEM=9.7-12.5 Nm,  $CV_{TE}=25.7$ -28.1%). Ratio limits of agreement analyses also resulted in better hip flexion and knee extension absolute reliability compared to other muscle groups (RLOA=25.7 & 35.7 vs. 66.7-74.8%).

**CONCLUSIONS:** Clinically, the absolute reliability results of this study can offer a guide as to whether a true change in strength has occurred in individuals or a group in response to an intervention. Generally, isometric strength testing using a dynamometer in 10-14 year old athletes was found to be reliable, however some athletes showed great variability between sessions. Certain strength tests may benefit from an added familiarization session to help eliminate systematic bias. Funding: Manitoba Health Research Council, Canadian Institutes of Health Research & Sport Medicine Council of Manitoba

92 Board #7 May 29, 9:30 AM - 11:30 AM

#### Reliability and Minimal Detectable Change of Hip Flexibility and Strength Measures in Youth Soccer Players

Darren J. Paul, George Nassis, Rod Whiteley, Joao B. Marques, Dean Kenneally, Hakim Chalabi. *ASPETAR Qatar Orthopaedic and Sports Medicine Hospital, Doha, Qatar.*  
(No relationships reported)

Groin injuries are a significant problem in soccer. The role of regular screening to allow for early identification of groin injury is considered a worthwhile preventative strategy and useful for quantifying match play load. However, to be considered a useful measuring tool, the minimal detectable change (MDC) and test reliability associated with hand held dynamometry (HHD) should be established.

**PURPOSE:** 1) Identify the MDC for HHD hip strength and flexibility measures 2) Determine inter- and intra- rater test-retest reliability for HHD hip strength and flexibility measures in youth soccer players.

**METHODS:** Twenty well-trained youth team soccer players (mean±SD age 16.7±1.3; weight 61.6±6.1kg; height 174.9±4.9cm) participated in the study. Intra and inter rater reliability was determined for bent knee fall out test, hip abduction and adduction. Reliability was evaluated with the Intraclass correlation coefficient (ICC[2,1]) and 95% confidence intervals (CI) and MDC derived from the ANOVA. Internal load was evaluated as rate of perceived exertion (RPE)\*match time.

## RESULTS:

Table 1. Minimal detectable change of strength and flexibility measures

Variable	Tester 1	Tester 2	Average of tester	% change (average)
Bent knee fall out (cm)				
Left	2	4.9	4.6	35%
Right	1.3	5.2	4.1	32%
Abduction (N.m kg <sup>-1</sup> )				
Left	4.9	5.2	4.9	25%
Right	5.3	5	4.1	21%
Adduction (N.m kg <sup>-1</sup> )				
Left	5.8	5	4.4	22%
Right	6.8	5.5	5.4	27%

Intrater reliability (ICC) range: bent knee fall out (0.59-0.70); abduction (0.82-0.93); adduction (0.72-0.96). Interrater reliability range: bent knee fall out test (0.64-0.77); abduction (0.78-0.82) adduction (0.62-0.65).

**CONCLUSION:** A change in muscle force production and flexibility of more than 27 and 35% is necessary to be considered a worthwhile change that is not due to measurement variation. Strength and flexibility measures, when performed by the same tester, possess moderate to high reliability. A threshold may exist in which match play load negatively impacts hip flexibility.

93 Board #8 May 29, 9:30 AM - 11:30 AM

#### Association Between Flexibility And Knee Alignment In Children And Adolescents

Sophia Luengas, Rafael mancini, Diogo Bezerra, victor matsudo. *CELAFISCS, São Caetano do sul, Brazil.*  
(No relationships reported)

**PURPOSE:** To analyze the association between flexibility of the lower limbs and knee alignment of Brazilian adolescents students of the longitudinal of growth, development and physical lifestyle in Project of Ilhabela. A transverse study.

**METHODS:** 720 children and adolescents between 6-18 years were measured with IMD (intermalleolar distance), ICD (intercondylar distance) and flexibility according to the CELAFISCS protocols, anthropometric variables were: weight, height and BMI. The sample was divided into female N=353 and male N=367.

**RESULTS:** The mean and standard deviation age was 11.3 (2.5), weight 41.5 (13.3), height 143.9 (28.2), flexibility 24.8 (6.8), ICD 2.5 (1.4), IMD 3.6 (2.5). In the male group we found a significant statistical correlation between flexibility and ICD  $p = 0.002$   $r = 0.19$ , the magnitude of the correlation was weak. We did not find a correlation between IMD and flexibility. In the women group there was not correlation between IMD and flexibility, IMD and ICD.

**CONCLUSIONS:** although there was a correlation between flexibility and ICD it was weak, therefore we cannot affirm that this hypothesis could happen in other different groups. We suggest going in deep these variables in different groups.

## A-27 Thematic Poster - It's All in the Core

May 29, 2013, 9:30 AM - 11:30 AM  
Room: 208

94 Chair: Ajit M. Chaudhari, FACSM. *Ohio State University, Columbus, OH.*  
(No relationships reported)

95 Board #1 May 29, 9:30 AM - 11:30 AM

**Do Anatomical Or Other Hip Characteristics Predispose To Lower Limb Musculoskeletal Injury? A Systematic Review**  
Eliza Hafiz, Claire Hiller, Leslie Nicholson, Kathryn Refshauge. *University of Sydney, Lidcombe, NSW, Australia.*  
(No relationships reported)

**BACKGROUND AND PURPOSE:** Anatomical and biomechanical features of the hip are normally investigated in people with hip pain and dysfunction. However, current literature has conflicting reports on the association between altered anatomical and biomechanical features in causing injury and pain to the joint and area distal to the hip. This review was undertaken to determine the association between hip abnormality and lower limb musculoskeletal injury.

**METHODS:** Studies were identified through a search without language restriction of PubMed, CINAHL, Web of Science, Embase, SportDiscus databases from the earliest date through October 2011 with subsequent searching of reference lists. Inclusion criteria were established before searching and all included studies underwent methodological quality assessment by 2 independent reviewers.

**RESULTS:** Of the 22,815 identified studies, 5 met the inclusion criteria with methodological quality 1 of 6 to 5 of 6. Hip abnormality studied were hip range of



motion and hip strength. No prospective data on femoral torsion and lower limb injury was found. Conflicting result was found on the association between altered hip features and lower limb injury. Excessive range of external rotation was found to be a predisposing factor to lower limb stress fracture in military recruits ( $p=0.0345$ ). Decreased total hip range of motion was found to be significant in soccer players suffering adductors injury ( $p=0.06$ ). However, hip external rotation and internal rotation range were not a predicting factor to non-contact ACL injury in dancers. Hip flexors and hip abductors strength on the injured side hip was significantly weaker in runners suffering lower limb running injury when compared to the non-injured side,  $p=0.026$  and  $p=0.0003$  respectively. However, hip adductors on the injured side was found to be significantly stronger ( $p=0.01$ ) than the non-injured side. Hip flexors in first time injured runners were significantly weaker when compared to reinjured runners,  $p=0.053$ . No significant difference in hip strength was found in dancers with and without non-contact ACL injury.

**CONCLUSION:** The finding of this review indicates that alteration in anatomical and biomechanical characteristic of the hip (range of motion and strength) predispose to lower limb injury.

#### 96 Board #2 May 29, 9:30 AM - 11:30 AM

##### The Effects Of External Pelvis Support On Core Proprioception And Dynamic Stability

Michael J. Decker, Casey A. Myers, Kevin B. Shelburne, Bradley S. Davidson. *University of Denver, Denver, CO.*  
Supported by MJ. Decker Consulting Fee; Opedix LLC.

Core stability dysfunction is commonly reported in the literature to place an individual at risk for knee, hip or low back injury.

**PURPOSE:** The purpose of this study was to examine the effects of external pelvis support on the ability to control the trunk over a mobile pelvis and the planted leg.

**METHODS:** Ten healthy participants (7 male; 3 female) performed a core proprioception task and a dynamic landing task while wearing form-fitting, athletic shorts with and without built in pelvis support (with, PS; without, NPS). For the core proprioception task, participants sat on an unstable chair balanced on a hemisphere (44 cm diameter), with eyes closed for three-10 sec trials. Core proprioception performance was represented by the average velocity of the 3D marker path length within the first 5 seconds of the unstable sitting task. Participants also performed 3 single leg landings onto a force platform from a horizontal distance normalized to greater trochanter height. Dynamic stability performance was calculated within the first 2 seconds of the landing phase using the center of pressure (COP) average velocities in the medio-lateral (ML) and anterior-posterior (AP) directions. Paired t-tests were used to compare core proprioception and dynamic stability between pelvis support conditions.

**RESULTS:** Core proprioception performance was improved on average by 16.0 % during the PS condition ( $p<0.05$ ; NPS,  $2.1 \pm 1.0$  cm/s; PS,  $1.5 \pm 0.8$  cm/s). Dynamic stability performance during landing was similar in the ML direction between pelvis support conditions ( $p>0.05$ ; NPS,  $31.0 \pm 4.2$  cm/s; PS,  $31.3 \pm 3.8$  cm/s) whereas dynamic stability was improved on average by 4.7% in the AP direction when landing with PS ( $p<0.05$ ; NPS,  $53.2 \pm 7.1$  cm/s; PS,  $50.7 \pm 5.8$  cm/s).

**CONCLUSION:** External pelvis support augmented the ability to control the trunk over a mobile pelvis and the planted leg. External pelvis support may be useful for training or rehabilitating core stability.

#### 97 Board #3 May 29, 9:30 AM - 11:30 AM

##### EMG Activation of Gluteal Musculature during Therapeutic Exercises With and Without Elastic Resistance

Jay Greenstein<sup>1</sup>, Barton Bishop<sup>1</sup>, Jena Etnoyer<sup>1</sup>, Robert Topp<sup>2</sup>.  
<sup>1</sup>Sport & Spine Rehab Clinical Research Foundation, Fort Washington, MD. <sup>2</sup>Marquette University, Milwaukee, WI.  
(Sponsor: Phil Page, FACSMM)  
(No relationships reported)

Gluteus medius (Gmed) and gluteus maximus (Gmax) muscle strength is important to consider in the treatment of several conditions including knee pain and low back pain. Few studies have evaluated exercises that activate the Gmed and Gmax to the highest degree while limiting tensor fascia latae (TFL) activation.

**PURPOSE:** This study evaluated the surface EMG activation of Gmed, Gmax, and TFL in full weight-bearing (FWB), partial weight-bearing (PWB), and non-weight-bearing (NWB) when performing exercises with elastic resistance (ER) and without resistance (NR).

**METHODS:** A convenience sample of 11 healthy male and females, 19-42 years of age, were recruited. The MVIC was established for each muscle using standard testing positions. 13 movements within 8 exercises of varying weight-bearing and resistance levels were evaluated in random order using surface EMG on the dominant leg. Raw EMG signals were rectified and smoothed using a root-mean-square algorithm and data was expressed as %MVIC. Independent t-tests were performed to compare Gmax to TFL activations and Gmed to TFL activations for each individual exercise. Additionally, exercises were rank ordered by the ratio of highest Gmax and Gmed activation to lowest TFL activation within weight-bearing levels.

**RESULTS:** In NWB, Gmax and Gmed were significantly greater ( $p<0.001$ ) than

TFL ( $25.35\% \pm 10.39\%$ ,  $25.35\% \pm 10.39\%$ ,  $11.16\% \pm 5.34\%$  respectively) in the ClamsER exercise. For PWB, although not significant for any exercise, the Gmax/TFL activation ratio was greatest during BridgeER and the Gmed/TFL activation ratio was greatest during the QuadrupedHipExtER. In FWB there was a significant difference ( $p=0.039$ ) between Gmed ( $55.36\% \pm 22.19\%$ ) and TFL ( $40.11\% \pm 22.87\%$ ) when performing RunningManER. Standing HipAbdNR (stance leg) produced significantly greater activation ( $p<0.001$ ) of the TFL ( $41.62\% \pm 13.97\%$ ) compared to Gmax ( $20.29\% \pm 10.98\%$ ).

**CONCLUSION:** The results of this study provide a rationale for an exercise prescription to strengthen the gluteal muscles while decreasing TFL activation, progressing from PWB to FWB. This sequence is ClamsER for NWB, BridgeER and QuadrupedHipExtER for PWB, and RunningManER for FWB. It is also recommended that Standing HipAbdNR (stance leg) not be used, as it activates the TFL greater than the Gmax.

#### 98 Board #4 May 29, 9:30 AM - 11:30 AM

##### The Effect of Core and Lower Limb Strengthening on Plantar Force Distribution

David Hudson. *Western Carolina University, Cullowhee, NC.*  
(No relationships reported)

Several common running injuries have been associated with dysfunction in the hip and foot. Weakness in the hip/core muscles has been found in people that load the foot more medially.

**PURPOSE:** To determine the effect of lower limb and core strengthening on plantar force distribution.

**METHODS:** A pedobarograph mat measured the force under the right foot during a single limb squat, before and after a 4-week strengthening program. The plantar force map from data collected during 5 consecutive single leg squats was divided into medial and lateral halves. A Plantar Force Index (PFI) was calculated from the ratio: medial force / whole force. Pre/post strength of the lower limb were tested by counting repetitions completed in 30 seconds during a single limb squat and heel raise. Core strength was assessed by counting repetitions of hip abductions from a side-plank position. Subjects completed a 4-week strengthening program including side-plank/hip abductions, "monster" walks and mini-squats with resistance band, and heel-raises. Subjects' data were stratified into three groups based on their baseline PFI (lateral, central, and medial). Separate 3X2 ANOVAs with repeated measures were used to test for significant pre/post changes in the PFI or strength.

**RESULTS:** Fifteen subjects completed the study. Table 1 contains the results of the pre/post measures of strength and PFI. Following the exercise program, subjects were significantly stronger ( $p \leq 0.05$ ) and the medial force group put significantly more force laterally under the foot ( $p < 0.02$ ).

**CONCLUSION:** People that bear more weight medially shifted more laterally after completing a strengthening program that targeted core, hip abductor/external rotator and calf muscles.

	Planks		Squats		Heel Raises		PFI	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Medial	6.0	18.2	28.8	41.6	38.8	49.6	0.59	0.52
Central	9.4	17.4	30.8	36.0	36.6	49.2	0.50	0.51
Lateral	16.6	21.8	31.0	36.8	44.0	51.0	0.41	0.46

#### 99 Board #5 May 29, 9:30 AM - 11:30 AM

##### The Relationship between Hip Function and Core Proprioception

Casey A. Myers, Michael J. Decker, Kevin B. Shelburne, Bradley S. Davidson. *University of Denver, Denver, CO.*  
(No relationships reported)

The interaction that exists between how the low back is stabilized through core muscles and the function of the hip may help explain mechanisms that lead to low back pain. Little research exists that quantifies this regional interdependence.

**PURPOSE:** 1) To define the quantitative relationship between clinically relevant measures of hip function and a novel assessment of core proprioception using unstable sitting and 2) To assess the effect of task difficulty on these relationships.

**METHODS:** Passive maximum hip internal/external range of motion and maximum adduction/abduction hip torque were measured bilaterally on ten healthy participants (7M, 3F) and asymmetry indices (ASI) were calculated. Participants sat on an unstable surface composed of a chair balanced on a hemisphere. Three ten second trials were collected in two task conditions: sphere diameter of 39 cm (more difficult) and 44 cm (less difficult) and two visual conditions: eyes open (EO) and eyes closed (EC). Core proprioception performance was assessed by the 3D path length of markers placed on the corners of the chair surface. Dependent variables were the average velocity of the 3D path length and the maximum 3D path length during the final five seconds of each trial. Hip asymmetries and core proprioception performance were related through Pearson product moment correlations and changes in core proprioception were compared across task difficulty using paired t-tests.

**RESULTS:** There were moderate positive correlations between path length and internal rotation ASI ( $r=0.58$ ), adduction strength ASI ( $r=0.48$ ), and a negative



correlation with dominant leg range of motion ( $r=0.46$ ). These correlations were stronger at the higher level of difficulty and were weaker with lower task difficulty. Path length was significantly higher in EC vs. EO ( $17.8\pm 12.6$  mm/s vs.  $6.1\pm 2.6$ ;  $p<0.01$ ) but was not different between lower and higher difficulty unstable sitting tasks.

**CONCLUSION:** These data indicate that core proprioception declines as hip asymmetries increase, particularly during more difficult tasks. The regional interdependence between the hip and low back is controlled through core muscle proprioception and the quantification of this relationship can assist clinicians in the diagnosis and treatment of low back pain.

100 Board #6 May 29, 9:30 AM - 11:30 AM

### Contribution of Trunk Kinematics to Post-Strike Ball Velocity During a Maximal Instep Soccer Kick

Brian Campbell, Adam M. Fullenkamp, James Bacher, Jr, C. Matthew Laurent. Bowling Green State University, Bowling Green, OH.  
(No relationships reported)

Several studies have shown that the lower extremity plays a significant role in the velocity of a soccer ball during a maximal instep kick. While much emphasis is placed on the swing velocity of the lower extremity, there is substantial momentum generated by trunk rotation which may play an equally crucial role in ball velocity. Although the importance of trunk kinematics is well established in other sports (e.g. golf), there has been limited emphasis on trunk motion in soccer research.

**PURPOSE:** To establish the relationship between trunk rotational kinematics and the velocity of a soccer ball following a maximal instep kick.

**METHODS:** A high-resolution 3-D motion analysis system was used to evaluate the maximal instep soccer kick of nine collegiate males. Following a structured warm-up and stretching protocol, each subject performed ten maximal instep kick trials. Trunk and hip kinematics were assessed by calculating the Euler rotation angle between the pelvis and trunk in the body's transverse plane and between the thigh and pelvis in the body's sagittal plane, respectively. Ball velocity was calculated by tracking five markers on the ball for a minimum of 10 frames immediately after the foot struck the ball.

**RESULTS:** The average post-strike ball velocity for the nine participants was  $48.2\pm 5.4$  mph, and velocities ranged from 38.5 mph to 58.5 mph. The average peak trunk rotation velocity for the nine participants was  $345.7\pm 142.3$  deg/sec, and ranged from 61.2 deg/sec to 655.6 deg/sec. Peak trunk rotation velocity was found to be strongly correlated with post-strike ball velocity ( $r^2=0.57$ ), suggesting that 57% of ball velocity is explained by peak trunk rotation velocity. Finally, the correlation between peak hip flexion velocity and post-strike ball velocity was assessed ( $r^2=0.39$ ).

**CONCLUSION:** The results of the study demonstrate the importance of trunk rotation velocity in the generation of momentum during a maximal instep soccer kick. While there is little doubt that the lower extremity plays an important role in producing greater ball velocities, it may be appropriate to suggest that training regimens also emphasize the importance of the trunk when increased ball velocity is a primary goal. Future research should evaluate the link between trunk-specific soccer training and changes in maximal instep kick velocity.

101 Board #7 May 29, 9:30 AM - 11:30 AM

### Force Test of Internal Rotation During Various Isometric Transverse Pelvic Girdle Rotations

Jaynesh Patel, Adam Jagodinsky, Gretchen Oliver, FACSM, Wendi Weimar. Auburn University, Auburn, AL.  
(No relationships reported)

The latissimus dorsi is the broadest muscle of the back, originating at the iliac crest and inserting on the humerus. As the latissimus dorsi muscle's actions primarily affect the shoulder, however based on the insertion points it was hypothesized that altering the pelvic could ultimately affect the shoulder.

**PURPOSE:** The purpose of this project was to investigate the differences of internal rotation strength in response to pelvic position.

**METHODS:** Seventeen physically active males current resistance-training males ( $21.7 \pm 1.04$  yrs.,  $183 \pm 6$  cm.,  $83.5 \pm 9.7$  kg.) volunteered to participate. Participants performed isometric internal shoulder rotation [90 degrees elbow flexion and shoulder abduction] on an isokinetic dynamometer for seven different conditions. Conditions were randomized: [1] neutral; [2, 3] 10 degrees contralateral pelvic rotation (CPR) and 10 degrees ipsilateral pelvic rotation [IPR]; [4, 5] 20 degrees CPR and IPR; [6, 7] full CPR and IPR. Each participant completed three, two second contractions of maximal isometric internal rotation and peak torque was recorded for each condition.

**RESULTS:** A 1 (Torque) x 8 (Condition) repeated measures ANOVA was completed in addition to pairwise comparisons between each condition. There were statistically significant main effects for maximal torque values between the neutral condition and conditions 10° IPR and 20° IPR ( $p<0.05$ ) [Figure 1].

Figure 1. Mean and S.D. of torque represented in foot-pounds. \* Significant difference [ $p<0.05$ ].

Neutral**	10° CPR	20° CPR	Full CPR	10° IPR *	20° IPR **	Full IPR
22.24 ± 6.58	20.08 ± 9.18	19.57 ± 6.67	19.97 ± 6.34	19.29 ± 6.39	19.48 ± 7.5	19.94 ± 8.77

**CONCLUSIONS:** The results of this study suggest that altering pelvic position does alter internal rotation force development, particularly with ipsilateral rotation, as is typically seen in overhand throwing motions.

102 Board #8 May 29, 9:30 AM - 11:30 AM

### Torque-EMG Relationship Of Lower Back Muscles - A Pilot Study

Stephan Kopinski, Tilman Engel, Steffen Mueller, Frank Mayer. University Outpatient Clinic Potsdam, Potsdam, Germany.  
(No relationships reported)

Measuring torque and muscle activation is common in research of chronic low back pain (CLBP). Combining both in a torque-innervation relationship (TIR) may be a relevant alternative to separate measurements. A respective protocol including maximal and submaximal isokinetic contractions (MVC; subMVC) and normalization of subMVC on MVC may reduce the influence of additional factors (e.g. pain, gender). **PURPOSE:** To validate a subMVC protocol comparing healthy males and females for differences in TIR.

**METHODS:** 12 healthy subjects (6 males:  $29\pm 1$  yrs,  $85\pm 9$  kg,  $1.85\pm 0.10$  m; 6 females:  $24\pm 2$  yrs,  $65\pm 5$  kg,  $1.67\pm 0.05$  m) performed isokinetic trunk extension/flexion strength tests. Being prepared with a 4 lead bilateral surface EMG on erector spinae (L3, Th9) subjects were positioned standing in the dynamometer. Within 10° extension and 45° flexion and a velocity of 45°/s they had to perform a set of concentric isokinetic tests: 30 repetitions warm-up followed by 5 repetitions with MVC and each 5 repetitions of subMVC at 20, 40, 60 and 80% of MVC with bio feedback to target the prescribed intensity. Finally, another MVC trial was performed for fatigue control. Peak torque for MVC (Nm, mean of 3 highest) and root mean square (EMG) for each subMVC (mV, mean of 5) were analysed (mean±SD) and normalized to MVC. An independent samples t-test was used to determine if the TIR was statistically different ( $\alpha<0.05$ ) between genders.

**RESULTS:** Absolute torque of MVC was higher in males than in females ( $374\pm 57$  to  $226\pm 58$  Nm). Normalized to MVC, EMG at the 4 subMVC (20, 40, 60, 80%) showed 26.5, 35.1, 47.5 and 63.2% in males, and 34.4, 49.1, 60.1, and 80.8% in females. Differences in TIR between gender, characterized by the MVC normalized EMG reached significance within subMVC of 40, 60 and 80% ( $p<0.05$ ). Initial and final MVC trials showed no significant difference for peak torque.

**CONCLUSIONS:** Overall, males needed substantially lower innervation to generate subMVC than females. The data of this pilot study suggests that the chosen protocol might be valid for differentiating TIR between genders. However, further research has to verify its validity in CLBP patients.

## A-28 Thematic Poster - Noninvasive Metabolic Monitoring in Skeletal Muscle

May 29, 2013, 9:30 AM - 11:30 AM  
Room: 104

103 Chair: Kevin McCully. University of Georgia, Athens, GA.  
(No relationships reported)

104 Board #1 May 29, 9:30 AM - 11:30 AM

### Reproducibility of Skeletal Muscle Oxidative Function and Postexercise Kinetics Using Near-Infrared Spectroscopy

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(No relationships reported)

Near-infrared spectroscopy (NIRS) is a non-invasive method of measuring muscle oxygenation and hemodynamics in skeletal muscle. **PURPOSE:** To assess the reproducibility of measuring resting blood flow, resting oxygen consumption, mitochondrial capacity, and physiological heme content in skeletal muscle using NIRS. **METHODS:** Seven healthy participants (3 male, 4 female) were tested on two occasions within a 3-day period. The NIRS device was placed on the medial gastrocnemius and venous and arterial occlusions were performed in order to obtain the resting blood flow and oxygen consumption. A series of repeated arterial occlusions was used to measure the recovery kinetics of muscle oxygen consumption after 7 seconds of voluntary plantar flexion exercise.

**RESULTS:** Resting blood flow and resting oxygen consumption had a mean coefficient of variation (CV) of 43.0% (mean ICC = 0.02) and 13.2% (mean ICC = 0.91) respectively. The recovery time constant of oxygen consumption had a mean CV of 8.9% (mean ICC = 0.92). The physiological heme content had a mean CV of 14.6% (mean ICC = 0.72).