

## Evidence-based Practice Initiative – ER, EvalTech, Evaluator, EV2

### “Hip strength and star excursion balance test deficits of patients with chronic ankle instability.”

McCann RS, Crossett ID, Terada M, Kosik KB, Bolding BA, Gribble PA: Hip strength and star excursion balance test deficits of patients with chronic ankle instability. J Sci Med Sport. 2017, <http://dx.doi.org/10.1016/j.jsams.2017.05.005>

#### ABSTRACT:

**Objectives:** To examine isometric hip strength in those with and without CAI, and determine the degree of Star Excursion Balance Test (SEBT) variance explained by isometric hip strength.

**Design:** Single-blinded, cross-sectional, case-control study.

**Methods:** Thirty individuals with CAI, 29 lateral ankle sprain (LAS) copers, and 26 healthy controls participated. We assessed dynamic postural control with the SEBT anterior (SEBT-ANT), posteromedial (SEBT-PM), and posterolateral (SEBT-PL) reaches, and isometric hip extension (EXT), abduction (ABD) and external rotation (ER) strength with hand-held dynamometry. The CAI and LAS coper groups' involved limbs and randomly selected limbs in controls were tested. Separate Kruskal–Wallis tests compared SEBT scores and isometric hip strength between groups. Backwards linear regression models determined the degree of SEBT variance explained by isometric hip strength. Statistical significance was set a priori at  $P < 0.05$ .

**Results:** The CAI group had lower SEBT-ANT scores compared to LAS copers ( $P = 0.03$ ) and controls ( $P = 0.03$ ). The CAI group had lower ABD compared to LAS copers ( $P = 0.03$ ) and controls ( $P = 0.02$ ). The CAI group had lower ER compared to LAS copers ( $P = 0.01$ ) and controls ( $P = 0.01$ ). ER ( $R^2 = 0.25$ ,  $P = 0.01$ ) and ABD ( $R^2 = 0.25$ ,  $P = 0.01$ ) explained 25% of the CAI group's SEBT-PM and SEBT-PL variances, respectively.

**Conclusions:** The CAI group had deficient dynamic postural control and isometric hip strength compared to LAS copers and controls. Additionally, the CAI group's isometric hip strength significantly influenced dynamic postural control performance. Future CAI rehabilitation strategies should consider hip muscular strengthening to facilitate improvements in dynamic postural control.

*Use of Evaluator portable load cell: musculoskeletal evaluation of strength of hip musculature of healthy individuals and individuals with CAI.*

### “Influence of functional capacity evaluation on physician’s assessment of physical capacity of veterans with chronic pain: a retrospective analysis.”

Peppers D, Figoni SF, Carroll BW, Chen MM, Song S, Mathiyakom W: Influence of functional capacity evaluation on physician’s assessment of physical capacity of veterans with chronic pain: a retrospective analysis. Am Acad Phys Med Rehabil. <http://dx.doi.org/10.1016/j.pmrj.2016.10.011>.

#### ABSTRACT:

**Background:** Physicians have difficulty predicting patients’ occupational limitations, abilities, and success from clinical evaluation (CE) of pathology and impairments, especially in the presence of chronic pain. Additional information from a functional capacity evaluation (FCE) may improve the accuracy of their physical capacity assessments. It is not known whether FCE information will change these assessments. No such study has been published using Veterans or non-Veterans.

**Objective:** To determine the influence of FCE data on the physician's assessment of the US Department of Labor's Dictionary of Occupational Titles (DOT) work capacity levels of Veterans with chronic moderate-intensity pain.

**Design:** Retrospective analysis.

**Setting:** Tertiary care medical center.

**Participants:** Veterans aged 18-60 years with moderate chronic musculoskeletal pain who were seeking employment.

**Methods:** Two kinesiotherapists performed FCEs on all participants, namely, the lumbar protocol of the EvalTech Functional Testing System (BTE, Inc, Hanover, MD). One physiatrist performed CE in all participants. Two other physiatrists assessed DOT physical capacity levels using CE data alone and later using combined CE and FCE data.

**Main Outcome Measurements:** DOT physical capacity level (sedentary = 1, light = 2, medium = 3, heavy = 4, very heavy = 5).

**Results:** Of 55 charts reviewed, 27 met inclusion/exclusion criteria. The mean age was 38 years, and there were 25 male and 2 female participants. The predominant pain location was the lower back. DOT scores for 2 physicians were averaged. The mean  $\pm$  SD DOT scores for CE only and CE+FCE conditions were  $2.04 \pm 0.33$  and  $2.40 \pm 0.90$ , respectively. In all, 65% of DOT scores changed (17% decreased and 48% increased at least 1 level) after FCE data were considered. A 1-sample *t* test revealed that the mean CE+FCE DOT score was significantly greater than the mean CE-only score (by 20%,  $P=.02$ ). Interrater agreement (weighted *k*) for CE+FCE-based DOT scores was much higher than for CE alone (0.715 versus 0.182).

**Conclusion:** The addition of FCE data to CE changed the majority of physician-assigned DOT levels. FCE significantly increased the mean DOT physical work capacity level provided by the physician to Veterans with chronic moderate-intensity pain, especially if the initial assessment was designated as "light." FCE may facilitate a more objective and accurate determination of Veterans' work capacity.

*Use of EvalTech system: musculoskeletal evaluation of functional capacity of veterans.*

## **"Predictive neuromuscular fatigue of the lower extremity utilizing computer modeling."**

Samaan MA, Weinhandl JT, Hans SA, Bawab SY, Ringleb SI: Predictive neuromuscular fatigue of the lower extremity utilizing computer modeling. *J Biomech Eng.* 2016; 138:011008-1-10.

### **ABSTRACT:**

This paper studies the modeling of lower extremity muscle forces and their correlation to neuromuscular fatigue. Two analytical fatigue models were combined with a musculoskeletal model to estimate the effects of hamstrings fatigue on lower extremity muscle forces during a side step cut. One of the fatigue models (Tang) used subject-specific knee flexor muscle fatigue and recovery data while the second model (Xia) used previously established fatigue and recovery parameters. Both fatigue models were able to predict hamstrings fatigue within 20% of the experimental data, with the semimembranosus and semitendinosus muscles demonstrating the largest (11%) and smallest (1%) differences, respectively. In addition, various hamstrings fatigue levels (10–90%) on lower extremity muscle force production were assessed using one of the analytical fatigue models. As hamstrings fatigue levels increased, the quadriceps muscle forces decreased by 21% ( $p<0.01$ ), while gastrocnemius muscle forces increased by 36% ( $p<0.01$ ). The results of this study validate the use of two analytical fatigue models in determining the effects of neuromuscular fatigue during a side step cut, and therefore, this model can be used to assess fatigue effects on risk of lower extremity injury during athletic maneuvers. Understanding the effects of fatigue on muscle force production may provide insight on muscle group compensations that may lead to altered lower extremity motion patterns as seen in noncontact anterior cruciate ligament (ACL) injuries.

*Use of EvalTech portable load cell: musculoskeletal evaluation. In context of the study, the device served as a portable fixed dynamometer and was used to induce fatigue of the hamstring muscles of healthy females.*

### **“Sustained isometric shoulder contraction on muscular strength and endurance: a randomized clinical trial.”**

Myers NL, Toonstra JL, Smith JS, Padgett CA, Uhl TL: Sustained isometric shoulder contraction on muscular strength and endurance: a randomized clinical trial. J Sports Phys Ther. 2015; 10(7):1015-1025.

#### **ABSTRACT:**

**Background:** The Advanced Throwers Ten Exercise Program incorporates sustained isometric contractions in conjunction with dynamic shoulder movements. It has been suggested that incorporating isometric holds may facilitate greater increases in muscular strength and endurance. However, no objective evidence currently exists to support this claim.

**Hypothesis/Purpose:** The purpose of this research was to compare the effects of a sustained muscle contraction resistive training program (Advanced Throwers Ten Program) to a more traditional exercise training protocol to determine if increases in shoulder muscular strength and endurance occur in an otherwise healthy population. It was hypothesized that utilizing a sustained isometric hold during a shoulder scaption exercise from the Advanced Throwers Ten would produce greater increases in shoulder strength and endurance as compared to a traditional training program incorporating a isotonic scapular plane abduction (scaption) exercise.

**Study Design:** Randomized Clinical Trial.

**Method:** Fifty healthy participants were enrolled in this study, of which 25 were randomized into the traditional training group (age:  $26 \pm 8$ , height:  $172 \pm 10$  cm, weight:  $73 \pm 13$  kg, Marx Activity Scale:  $11 \pm 4$ ) and 25 were randomized to the Advanced Throwers Ten group (age:  $28 \pm 9$ , height:  $169 \pm 23$  cm, weight:  $74 \pm 16$  kg, Marx Activity Scale:  $11 \pm 5$ ). No pre-intervention differences existed between the groups ( $P > 0.05$ ). Arm endurance and strength data were collected pre- and post-intervention using a portable load cell (BTE Evaluator, Hanover, MD). Both within and between group analyses were done in order to investigate average torque (strength) and angular impulse (endurance) changes.

**Results:** The traditional and Advanced Throwers Ten groups both significantly improved torque and angular impulse on both the dominant and non-dominant arms by 10–14%. There were no differences in strength or endurance following the interventions between the two training groups ( $p > 0.75$ ).

**Conclusions:** Both training approaches increased strength and endurance as the muscle loads were consistent between protocols indicating that either approach will have positive effects.

*Use of Evaluator portable load cell (PLC): musculoskeletal evaluation of isometric torque and endurance via angular impulse of shoulder abductor muscles of healthy adults. The PLC served as a portable fixed dynamometer. Intersession reliability was established and ICC, SEM, and MDC were calculated for average torque and angular impulse using the PLC.*

### **“Based on upper extremity comfort ROM of ergonomic methods for household products design.”**

Yang F, Zhoy Q, Yang A, Hu H, Zhang X, Liu Z: Based on upper extremity comfort ROM of ergonomic methods for household products design. V.G. Duffy (ed.): DHM. 2014; LNCS 8529, pp 167-173.

#### **ABSTRACT:**

The structure of product demands a higher level of user performance and involves risk that may possibly negatively impact the user's safety and health. For this reason, the evaluation or design of new products

requires extensive knowledge of human interaction, including the operation and comfort of motion. This paper presents a technique for assessment of the upper extremity comfortable ROM. The method is based on new experimental data from perceived discomfort of subjects, and uses digital human modeling (DHM) systems to verify the perceived discomfort rank. 55 participants participated in this experiment. They were required to extract and insert pegs from different panels. We get the comfort ROM of subjects according to subjective comfortable ratings and use digital DHM systems to verify the perceived discomfort rank. In this paper, comfortable motion range of the 50th percentile was shown only. Using DHM systems, we can supply upper limb comfortable motion range of different percentile Chinese people for household products ergonomics design.

*Use of EvalTech FROM board: in the context of the study, the FROM board was used to study human-products compatibility and determine comfortable range of motion of the human upper limb.*

### **“Electrical stimulation for chronic non-specific low back pain in a working-age population: a 12-week double blinded randomized controlled trial.”**

Thiese MS, Hughes M, Biggs J: Electrical stimulation for chronic non-specific low back pain in a working-age population: a 12-week double blinded randomized controlled trial. *BMC Musculoskel Disord*. 2013; 14:117-126.

#### **ABSTRACT:**

**Background:** Non-invasive electrotherapy is commonly used for treatment of chronic low back pain. Evidence for efficacy of most electrotherapy modalities is weak or lacking. This study aims to execute a high-quality, double blinded randomized controlled clinical trial comparing 1) H-Wave® Device stimulation plus usual care with 2) transcutaneous electrical nerve stimulation (TENS) plus usual care, and 3) Sham electrotherapy plus usual care to determine comparative efficacy for treatment of chronic non-specific low back pain patients.

**Methods/Design:** Patients- Chronic non-specific low back pain patients between ages of 18–65 years, with pain of at least 3 months duration and minimal current 5/10 VAS pain. Patients will have no significant signs or symptoms of lumbosacral nerve impingement, malignancy, spinal stenosis, or mood disorders.

**Study design:** Double blind RCT with 3 arms and 38 subjects per arm. Randomization by permuted blocks of random length, stratified by Workers Compensation claim (yes vs. no), and use of opioids. The null hypothesis of this study is that there are no statistically significant differences in functional improvement between treatment types during and at the end of a 12-week week treatment period.

**Data collection-** Subjective data will be collected using Filemaker Pro™ database management collection tools. Objective data will be obtained through functional assessments. Data will be collected at enrollment and at 1, 4, 8, and 12 weeks for each participant by a blinded assessor.

**Interventions-** H-Wave® device stimulation (Intervention A) plus usual care, transcutaneous electrical nerve stimulation (TENS) (Intervention B) plus usual care, and sham electrotherapy plus usual care (control). Each treatment arm will have identical numbers of visits (4) and researcher contact time (approximately 15 hours).

**Outcomes- Primary outcome measure:** Oswestry Disability Index. Secondary measures include: Rowland Morris Instrument, VAS pain score, functional evaluation including strength when pushing and pulling, pain free range of motion in flexion and extension. Outcome measures assessed at baseline, 1, 4, 8, and 12 weeks. Treatment failure will be defined if patient terminates assigned treatment arm for non-efficacy or undergoes invasive procedure or other excluded cointerventions. Data will be analyzed using intention-to-treat analysis and adjusted for covariates related to LBP (e.g. age) as needed.

**Discussion:** Study strengths include complex randomization, treatment group allocation concealment, double blinding, controlling for co-interventions, rigorous inclusion criteria, assessment of compliance,

plans for limiting dropout, identical assessment methods and timing for each treatment arm, and planned intention-to-treat analyses.

*Use of EvalTech system: musculoskeletal evaluation of functional capacity of patients with non-specific chronic low back pain. Tests include lumbar AROM, shoulder height push and pull, cart height push and pull.*

### **“Test-Retest reliability and validity of isometric knee-flexion and –extension measurement using 3 methods of assessing muscle strength.”**

Toonstra J, Mattacola CG: Test-Retest reliability and validity of isometric knee-flexion and –extension measurement using 3 methods of assessing muscle strength. J Sport Rehabil. 2013; Feb 18; Technical Notes(7). pii:2012-0017.

#### **ABSTRACT:**

**Context:** Physicians and clinicians need portable, efficient, and cost-effective assessment tools to determine the effectiveness of rehabilitation programs after knee injury. Progress in rehabilitation should be evaluated using valid and reliable measurement methods.

**Objective:** To examine the test–retest reliability of portable fixed dynamometry (PFD), handheld dynamometry (HHD), and isokinetic dynamometry (IKD). In addition, the authors sought to examine the validity of PFD and HHD by comparing differences in peak torque of the knee flexors and extensors to that of the “gold standard” IKD.

**Design:** Repeated measures.

**Participants:** 16 healthy subjects (age  $29.3 \pm 7.2$  y, height  $167.4 \pm 8.04$  cm, mass  $73.7 \pm 20.0$  kg).

#### **Main Outcome Measures:**

The dependent variables were peak torque (normalized to body weight) of the knee flexors and extensors; the independent variables were trial (trial 1, trial 2) and instrument (IKD, PFD, and HHD).

**Results:** Test–retest reliability was high for both PFD and IKD. However, fair to poor reliability was found for HHD. There were no differences in peak torque (Nm) between IKD and PFD. However, significant differences in peak torque were observed between IKD and HHD and between PFD and HHD.

**Conclusions:** PFD provides reliable measures of strength and also demonstrates similar output measures as IKD. Its portability, ease of use, and cost provide clinicians an effective means of measuring strength.

*Use of Evaluator portable load cell (PLC): in context of study, the PLC was used as a portable fixed dynamometer to measure isometric peak torque of the knee flexor and extensor muscles of healthy population. Device was compared to “gold standard” measurement device and reliability measures were established.*

### **“A feedback inclusive neuromuscular training program alters frontal plane kinematics.”**

Greska EK, Cortes N, Van Lunen BL, Onate JA: A feedback inclusive neuromuscular training program alters frontal plane kinematics. J Strength Cond Res. 2012; 26(6):1609-1619.

#### **ABSTRACT:**

Anterior cruciate ligament (ACL) neuromuscular training programs have demonstrated beneficial effects in reducing ACL injuries, yet further evaluation of their effects on biomechanical measures across a sports team season is required to elucidate the specific factors that are modifiable. The purpose of this study was to evaluate the effects of a 10-week off-season neuromuscular training program on lower



extremity kinematics. Twelve Division I female soccer players (age:  $19.2 \pm 0.8$  years, height:  $1.67 \pm 0.1$  m, weight:  $60.2 \pm 6.5$  kg) performed unanticipated dynamic trials of a running stop-jump task pretraining and post-training. Data collection was performed using an 8-camera Vicon system (Los Angeles, CA, USA) and 2 Bertec (Columbus, OH, USA) force plates. The 10-week training program consisted of resistance training 2 times per week and field training, consisting of plyometric, agility, and speed drills, 2 times per week. Repeated measures analyses of variance (ANOVAs) were used to assess the differences between pretraining and post-training kinetics and kinematics of the hip, knee, and ankle at initial contact (IC), peak knee flexion (PKF), and peak stance. Repeated measures ANOVAs were also used to assess isometric strength differences pre-training and post-training. The alpha level was set at 0.05 a priori. The training program demonstrated significant increases in left hip extension, left and right hip flexion, and right hip adduction isometric strength. At IC, knee abduction angle moved from an abducted to an adducted position ( $-1.48 \pm 3.65^\circ$  to  $1.46 \pm 3.86^\circ$ ,  $p = 0.007$ ), and hip abduction angle increased ( $-6.05 \pm 4.63^\circ$  to  $-10.34 \pm 6.83^\circ$ ,  $p = 0.007$ ). Hip abduction angle at PKF increased ( $-2.23 \pm 3.40^\circ$  to  $6.01 \pm 3.82^\circ$ ,  $p = 0.002$ ). The maximum knee extension moment achieved at peak stance increased from pre-training to post-training ( $2.02 \pm 0.32$  to  $2.38 \pm 0.75$  N·m·kg<sup>-1</sup>,  $p = 0.027$ ). The neuromuscular training program demonstrated a potential positive effect in altering mechanics that influence the risk of incurring an ACL injury.

***Use of Evaluator portable load cell: musculoskeletal evaluation of isometric strength of hip and knee muscles of female soccer players. The PLC was configured as a portable fixed dynamometer.***

### **“Effects of a combined resistance-plyometric training program on muscular strength, running economy, and VO<sub>2</sub>PEAK in Division I female soccer players.”**

Grieco CR, Cortes N, Greska EK, Lucci S, Onate J: Effects of a combined resistance-plyometric training program on muscular strength, running economy, and VO<sub>2</sub>PEAK in Division I female soccer players. *J Strength Cond Res.* 2012; 26(9):2570-2576.

#### **ABSTRACT:**

Resistance and plyometric training programs have demonstrated consistent improvements in running economy (RE) in trained and untrained adults in the absence of improvements in maximal oxygen consumption. The purpose of this study was to investigate the effect of a 10-week combined resistance-plyometric training program on the RE and VO<sub>2</sub>max in female soccer players. Fifteen Division 1A female soccer players (age  $19.0 \pm 0.7$  years; height  $1.67 \pm 0.1$  m; weight  $61.7 \pm 8.1$  kg) performed a treadmill test for VO<sub>2</sub>max and RE at the end of a competitive season (PRE) and after a 10-week training program (POST). Isometric strength was measured in knee flexion and extension. Resistance training was conducted 2 d·wk<sup>-1</sup> on nonconsecutive days; plyometric training was conducted separately on different nonconsecutive days. Eleven subjects were included in the PRE-POST analysis (age  $19.0 \pm 0.8$  years; height  $1.67 \pm 0.5$  m; weight  $59.9 \pm 6.7$  kg). Descriptive statistics were compared using analysis of variance with repeated measures with a Bonferroni adjustment, and significance was set at  $p < 0.05$ . A significant increase occurred after training in the  $\dot{V}O_{2peak}$  (10.5%;  $p = 0.008$ ), time to fatigue (6.9%;  $p = 0.017$ ), and interpolated maximal speed (3.6%;  $p = 0.016$ ), despite there being a decrease in the maximal respiratory exchange ratio (2.9%;  $p = 0.001$ ). There was no significant change in the RE at 9 km·h<sup>-1</sup>; however, there was a significant decrease in the percentage of the  $\dot{V}O_{2peak}$  at 9 km·h<sup>-1</sup> (-5.6%;  $p = 0.02$ ). Maximal isometric strength of knee flexors and extensors did not change. The results suggest a plyometric-agility training program may increase the  $\dot{V}O_{2peak}$  in female soccer players; however, the effect on RE was equivocal.

*Use of Evaluator portable load cell: musculoskeletal evaluation of isometric strength of knee flexor and extensor muscles of female soccer players. The PLC was configured as a portable fixed dynamometer.*

### **“The reliability of portable fixed dynamometry during hip and knee strength assessments.”**

Kollock RO, Onate JA, Van Lunen B: The reliability of portable fixed dynamometry during hip and knee strength assessments. *J Athl Train.* 2010; 45(4):349-356.

#### **ABSTRACT:**

**Context:** Insufficient lower extremity strength may be a risk factor for lower extremity injuries such as noncontact anterior cruciate ligament tears. Therefore, clinicians need reliable instruments to assess strength deficiencies.

**Objective:** To assess the intra-rater, inter-rater, intra-session, and intersession reliability of a portable fixed dynamometer in measuring the strength of the hip and knee musculature.

**Design:** Crossover study.

**Setting:** Sports medicine research laboratory.

**Patients or Other Participants:** Three raters (A, B, C) participated in this 2-phase study. Raters A and B tested 11 healthy college graduate students (2 men, 9 women) in phase 1. Raters A and C tested 26 healthy college undergraduate students (7 men, 19 women) in phase 2.

**Main Outcome Measure(s):** The dependent variables for the study were hip adductor, hip abductor, hip flexor, hip extensor, hip internal rotator, hip external rotator, knee flexor, and knee extensor peak force.

**Results:** The phase 1 intra-session intraclass correlation coefficients for sessions 1, 2, and 3 ranged from 0.88 to 0.99 (SEM 5 0.08–3.02 N), 0.85 to 0.99 (SEM 5 0.26–3.88 N), and 0.92 to 0.96 (SEM 5 0.52–2.76 N), respectively. Intraclass correlation coefficients ranged from 0.57 to 0.95 (SEM 5 1.72–13.15 N) for phase 1 intersession values, 0.70 to 0.94 (SEM 5 1.42–9.20 N) for phase 2 intra-rater reliability values, and 0.69 to 0.88 (SEM 5 1.20–8.50 N) for phase 2 inter-rater values.

**Conclusions:** The portable fixed dynamometer showed good to high intra-session and intersession reliability values for hip and knee strength. Intra-rater and inter-rater reliability were fair to high, except for hip internal rotation, which showed poor reliability.

*Use of Evaluator portable load cell: musculoskeletal evaluation of isometric strength of hip and knee muscles of healthy undergraduate and graduate students. The PLC was configured as a portable fixed dynamometer. Intra- and intersession and intra- and interrater reliability values were established.*

### **“A strength-endurance index for power grip.”**

Jones DW, Robertson LD, Fighi SF: A strength-endurance index for power grip. *J Occup Rehabil.* 2009; 19:56-63.

#### **ABSTRACT:**

**Introduction:** The purpose of this study was to quantify muscle strength and endurance in power grip.

**Method:** Workers (74 M and 74 F, 18–72 years) squeezed a dynamometer for a 60 s, 18-cycle test. Initial strength (IS) and final strength (FS) were calculated as the mean peak force for cycles 1–3 and 16–18, respectively. Endurance was defined by the strength decrement index (SDI) where  $SDI = (IS - FS)/IS \times 100$ . A grip strength-endurance analyzer was constructed from IS and SDI data which were depicted on two parallel, linearly scaled axes. Discrete IS and SDI scores were connected on each axis with a vector. The vector (Vmag) was measured directly from the analyzer and its direction identified from its slope.

Integer scales transformed discrete IS and SDI scores into individual strength-endurance performance scores (SEPS).

**Results:** Better than 95% of the sample ( $n = 141$ ) scored within acceptable test ranges defined as the combined sample mean  $\pm 2SD$ , for SDI, Vmag and SEPS. Vmag was the best predictor for SEPS. Linear regression for SEPS was  $SEPS (combined) = 0.09 (Vmag) - 0.29$ ; ( $SEE = 0.829$ ). The analyzer revealed individual scores outside acceptable ranges for injured and uninjured efforts.

**Conclusion:** The development of a power grip strength-endurance analyzer provided a simple method to graph individual power grip performances. Converting strength and endurance scores to integers and summing them (SEPS) provided a simple means to represent individual estimates of power grip strength-endurance performance.

*Use of ER hand grip dynamometer: musculoskeletal evaluation of hand grip strength and endurance of workers.*

### **“Ergonomics and work assessments.”**

Innes E: Ergonomics and work assessments. In Jacobs K (ed). *Ergonomics for Therapists*. St. Louis, MO: Mosby Elsevier; 2008:48-72.

*Use of ER/EvalTech system: in functional and work capacity evaluations.*

### **“The high-speed Navy: vessel motion influences on human performance.”**

McCauley ME, Pierce EC, Matsagas P: The high-speed Navy: vessel motion influences on human performance. *Naval Eng J*. 2007;119:35-44.

#### **ABSTRACT:**

This paper presents the recent results from an ongoing analysis of the effects of high speed naval operations on the performance, comfort, and safety of crew and passengers. A 127 meter trimaran, the Benchijigua Express, which is similar in hull design to the General Dynamics Littoral Combat Ship (LCS) vessel, was investigated for motion-induced interruptions, motion sickness, and biodynamic feed-through to manual tasks. Data were obtained on two 2-hr transits per day for a total of 86 transits during February and March 2006. Survey questionnaires were obtained from nearly 2000 passengers. The motion effects on manual dexterity were negligible, but motion sickness symptoms were reported by a majority of the passengers. The capability to manage the motion sickness issue for unadapted passengers may be important for the effective use of LCS to transport ground combatants and for Sea Basing concepts.

*Use of FROM Board: in the context of this study to measure the effect of wave height on manual dexterity (speed and accuracy) in both the standing and stooping positions.*

### **“Changes in physical capacity as a function of age in heavy manual work.”**

Gall B, Parkhouse W: Changes in physical capacity as a function of age in heavy manual work. *Ergonomics*. 2004; 47(6):671-687.

#### **ABSTRACT:**

The objective of this study was to assess the changes in the physical capacity as a function of age in power line technicians (PLTs). The physical test was designed to closely represent the essential physical



tasks of the occupation that were identified through a detailed job demand analysis. The results from the physical test showed that six out of nine test variables did not demonstrate a statistical difference between the mean scores of young (4.39 years) and old age (50+ years) groups. However, the older group scored significantly lower in the aerobic capacity test, one-handed pull down, and both right and left standard handgrip tests. Despite these differences the older PLT appears to meet and exceed the physical requirements necessary to carry out the essential tasks of this trade. However, a physical test with a high level of content and construct validity is necessary to accurately evaluate the workers physical capacity in relation to the job demands. Based on the principal of specificity for muscle training and testing, this study has demonstrated that heavy manual work appears to maintain physical capacity specific to the task as age progresses.

***Use of Hanoun FOCUS: musculoskeletal evaluation isometric muscle strength required by work-related tasks of power line technicians. Tests included static one- and two-handed lifts, static one-handed pull down, standard and awkward hand grip strength (static). The column load cell and hand grip dynamometer were utilized for these tests. Reliability and validity of the test battery were established.***

### **“Reliability and reactivity of three new functional assessment measures.”**

Matheson LN, Rogers LC, Kaskutas V, Dakos M: Reliability and reactivity of three new functional assessment measures. *Work*. 2002; 18:41-50.

#### **ABSTRACT:**

This study of the reliability of three new tests of work performance considered the effect of test reactivity on measured performance. The tests are components of an employment screening battery designed for placement of applicants in automotive assembly jobs. Statistical measures of reliability were compared with a simple measure of test reactivity in a sample of 51 healthy adults. The effect of test reactivity on employment selection decisions using various cut scores was studied. Test reactivity is found to be a significant threat to reliability that must be considered when skill-based performance tests are used on a serial basis. When intended for use on a serial basis, such tests should be studied for both reliability and reactivity. In addition to reporting traditional statistical indices of reliability, an index of the reactivity should be reported.

***Use of ER FROM board: in the context of the study, three FROM tests which utilize time and motion studies were performed; Overhead Reach, Stoop Reach, and Kneel Reach. Tests were performed by healthy subjects. Reliability and reactivity measures were established.***