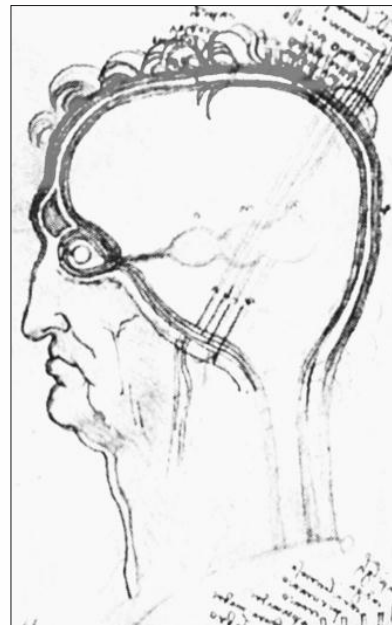


International Scientific Conference  
**MOTOR CONTROL 2012**  
From Theories to Clinical Application

---

Book of abstracts



27-29 September, 2012  
Wisła, Poland



*International Scientific Conference  
Motor Control 2012 – From Theories to Clinical Applications*

---



*International Scientific Conference*  
***Motor Control 2012***  
*Form Theories to Clinical Applications*

27<sup>th</sup> – 29<sup>st</sup> September 2012  
Wisła, Poland

***BOOK OF ABSTRACTS***

Edited by Kajetan Słomka and Grzegorz Juras



### *Organising Committee*

Kajetan Słomka - Chair  
Mariusz Furmanek  
Bogusława Gierat  
Katarzyna Górską  
Patrycja Kołacz  
Karina Nowak  
Magdalena Piecha  
Grzegorz Sobota

### *Scientific Committee*

Grzegorz Juras (Chair) (Poland)  
Bogdan Bacik (Poland)  
Klaus Blischke (Germany)  
Janusz Błaszczyk (Poland)  
Slobodan Jaric (USA)  
Mark Latash (USA)  
Mindy Levin (Canada)  
Joachim Raczek (USA)  
Zbigniew Waśkiewicz (Poland)



## Contents

### *Keynote presentations:*

<b>Anticipatory postural adjustments: what we know and what we don't</b>	
Alexander S. Aruin.....	10
<b>Sleep-related enhancement consolidation in motor skill learning - moving beyond the SRTT-paradigm</b>	
Klaus Blischke, Andreas Manalgré .....	11
<b>Ageing, motor output variability and learning novel motor tasks</b>	
Evangelos A.Christou, Tanya Onushko, Fox E.J., Baweja H.S., Kwon M.H., Chen Y.T., Kim C., and Larkin K. ....	12
<b>Plasticity and variability of motor unit contractile properties</b>	
Jan Celichowski.....	13
<b>Contrasting views on human postural control</b>	
Marcos Duarte .....	14
<b>Grip force control in static manipulation tasks</b>	
Slobodan Jaric.....	15
<b>Study on neuromuscular plasticity in humans related to disease and exercise</b>	
Anna Jaskólska .....	16
<b>Movements that are both variable and optimal</b>	
Mark Latash.....	18
<b>Movement and balance control limitations related to obesity</b>	
Normand Teasdale .....	19
<b>Learning a complex visuo-motor task and balance control in older individuals</b>	
Normand Teasdale, Simoneau M., Tessier J.-F., Gagné Lemieux L, Blouin J.....	21



*Poster presentations:*

<b>Reduced Dual Task Interference in Multiple Repeated Dual-Task Tests: Automatization or Task Integration?</b>	
Manfred Agethen, Daniel Krause.....	24
<b>The possibilities of clinical assessment of patients with Parkinson’s disease after Deep Brain Stimulation (DBS) based on Motion Capture data. Preliminary results</b>	
Magdalena Boczarska-Jedynak, Stanisław Kwiek ,Bartłomiej Czechowicz, Maria Flak, Magdalena Stawarz, Adam Światoński, Andrzej Polański, Konrad Wojciechowski, Andrzej Przybyszewski, Grzegorz Opala.....	25
<b>Functional limit of stability in relation to standing on inclined surface</b>	
Kristína Bučková, Zuzana Halická, Jana Lobotková, František Hlavačka .....	27
<b>Effects of military exercises on joint position sense and injury in conscripts</b>	
Etemadi Yasaman Sadat, Mohammadi Farshid .....	28
<b>Strategy of safety during gait of the expectant mother</b>	
Wanda Forczek, Robert Staszkiwicz .....	29
<b>Effects of supplementary endurance training on postural stability in classical dancers</b>	
Artur Fredyk, Ewelina Smol .....	30
<b>The Reliability of Force Production Error in Healthy Individuals</b>	
Mariusz Furmanek, Kajetan Słomka,Grzegorz Juras .....	31
<b>Fine motor control and indicators of school readiness 6 years old children</b>	
Bogusława Gierat .....	32
<b>The effect of externally added movement amplitude variability on motor learning</b>	
Mei-Chun Guo, Ing-Shiou Hwang .....	33
<b>How visual biofeedback magnification affects upright stance</b>	
Zuzana Halická, Jana Lobotková, Kristína Bučková, František Hlavačka .....	34
<b>The method of hurdle runs’ teaching and the results of special field tests and laboratory tests</b>	
Janusz Iskra, Jarosław Gasilewski, Jolanta Hyjek.....	35
<b>Twitch contractile properties after two bouts of eccentric exercise of the elbow flexors muscles</b>	
Damian Janecki, Jarosław Marusiak, Renata Andrzejewska, Anna Jaskólska, Artur Jaskólski .....	36
<b>Efficiency during cycling: the effect of altered pedaling speed on muscle activities</b>	
Peter Katona, Jozsef Laczko .....	37



<b>Fifteen minute treatment with low frequency, high intensity transcutaneous electrical nerve simulation (TENS) increases maximum</b>	
Sohit Karol, Jae Kun Shim.....	38
<b>The influence of whole-body cryostimulation on muscle regeneration after intensive physical exercise</b>	
Magdalena Kępińska, Zbigniew Szyguła .....	39
<b>The changes in chosen aspects of motor coordination in girls aged 16 years – a preliminary results of one decade study (2002 – 2012)</b>	
Małgorzata Kozłowska, Beata Juras, Grzegorz Juras, Joachim Raczek .....	40
<b>Flexion withdrawal reflex in multiple sclerosis: therapeutic use for stair climbing. A case report</b>	
Carmen Krewer, Jochen Quintern .....	42
<b>The influence of base of support perturbation on limits of stability</b>	
Patrycja Kołacz, Rafał Zajęc, Krzysztof Szydło, Kajetan Słomka, Grzegorz Juras .....	43
<b>Comparison of mechanical parameters of the vertical jump with varying load muscles in basketball players</b>	
Henryk Król.....	44
<b>Comparative analysis backward somersault tuck and picked</b>	
Henryk Król, Małgorzata Klyszcz-Morciniec, Grzegorz Sobota.....	45
<b>The influence of pilates exercises on the postural stability of young and older women - the comparison of effects of a short-term training</b>	
Lidia Kuba, Artur Fredyk, Izabela Zajęc-Gawlak, Joanna Kantyka .....	46
<b>Changes in fine motor behavior with age (based on visuo-proprioceptive and proprioceptive only feedbacks)</b>	
Liudmila Liutsko, Ruben Muiños and Josep Maria Tous-Ral.....	47
<b>Step initiation: characteristics from accelerometry and camera motion capture system</b>	
Jana Lobotkova, Zuzana Halicka, Kristina Buckova, Frantisek Hlavacka.....	48
<b>Postural stability changes after moderate effort in elderly depending on blood pressure</b>	
Janusz Maciaszek, Rafał Stemplewski, Wiesław Osiński.....	49
<b>ARNI training may affect levels of Activity and Participation in stroke survivors</b>	
Amir A. Mohagheghi, N. Theis, M. Norris, C. Kilbride.....	50
<b>EMG signal analysis the mvc test before and after functional testing in patients with gonarthrosis</b>	
Karina Nowak, Grzegorz Sobota, Bogdan Bacik , Grzegorz Hajduk Damian Kusz ....	51
<b>Building system of forecasting results jump height on neuro-fuzzy network cascade</b>	
Grigory Popov, I.U. Kriveckij, N.S. Bezrukov .....	52

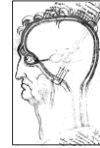


<b>Electromyographic activity pattern during gradual deactivation of the quadriceps femoris muscle</b>	
Katarzyna Kisiel-Sajewicz, Joanna Mencil, Siemionow V., Zhang L.D., Anna Jaskólska, Artur Jaskólski, Yue G.H.....	53
<b>Modification of exercise by mehrsheed sinaki and nordic walking for secondary prevention in osteoporosis</b>	
Agnieszka Nawrat-Szołtysik, Józef Opara, Cezary Kucio.....	54
<b>Effectiveness of different types of verbal feedback during the learning of a complex motor task</b>	
Tomasz Niżnikowski, Jerzy Sadowski, Andrzej Mastalerz.....	55
<b>Motor Learning is Enhanced in Older Adults following Training with a Less Difficult Task</b>	
Tanya Onushko, Changki Kim, Evangelos A. Christou.....	56
<b>Functional movement patterns and limitations vs. physical fitness preparation of 18 year old footballers</b>	
Marzena Paruzel - Dyja, Leszek Dyja, Janusz Iskra, Jarosław Wasilewski .....	57
<b>Influence of carrying out the execution criteria, during a shot on goal. Relationship between two groups of students from secondary school trained and untrained in soccer</b>	
César Peixoto, Cátia Valente, Miguel Moreira .....	58
<b>Sport results in weightlifting and their determinations</b>	
Anna Pilis, Krzysztof Mizera, Cezary Michalski, Jakub Jelonek, Łukasz Grela, Karol Pilis .....	59
<b>The use of selected linear models in predicting the results of 400-metre hurdles races</b>	
Krzysztof Przednowek, Janusz Iskra, Stanisław Cieszkowski .....	60
<b>The impact of sportive dancing compared to endurance/ strength training on cognitive skills in elderly</b>	
Kathrin Rehfeld, Anita Hökelmann, Wolfgang Lehmann, Peter Blaser .....	61
<b>Balance Asymmetry Quotient - The importance of separate measurements of lower limbs in posturography</b>	
Mariusz Strzecha, Henryk Knapik, Paweł Baranowski, Jan Pasiak, Agata Pękała, Karol Senderowicz.....	62
<b>The influence of the additional task on postural stability</b>	
Krzysztof Szydło, Kajetan Słomka, Rafał Zając, Patrycja Kołacz, Grzegorz Juras .....	63
<b>Changes in the level of stability while standing on the balance platform on a rigid and compliant surface</b>	
Dariusz Tchórzewski, Janusz Jaworski .....	64
<b>Fitness assessment in ice hockey</b>	



Milan Turek, Marek Kokinda, Robert Kandrac .....	65
<b>Hockey fitness relative to age categories</b>	
Milan Turek, Marek Kokinda, Robert Kandrac .....	66
<b>Specificity of learning in stabilometer balance tasks with and without vision</b>	
Martin Wünnemann .....	67
<b>Reliability of jumping test as a tool for evaluation of rhythm of movement</b>	
Rafał Zajac, Krzysztof Szydło, Patrycja Kołacz, Kajetan Słomka, Grzegorz Juras .....	68
<b>Impact of exercise intensity on inner plexiform layer of the retina</b>	
Teresa Zwierko, Lubiński W., Krzepota J., Lesiakowski P., Czepita D. ....	69





# Keynote Presentations



## **Anticipatory postural adjustments: what we know and what we don't**

**Alexander S. Aruin**

University of Illinois at Chicago, Chicago, USA

Humans commonly experience perturbations applied to their body resulting in the displacement of the body's center of mass (COM) closer to or beyond the boundaries of the base of support, thus compromising balance. The central nervous system (CNS) uses two main strategies to restore balance if it is distorted by a perturbation: (1) anticipatory postural adjustments (APA) seen as the activation of the trunk and leg muscles prior to the expected body perturbations; APAs serve to minimize the displacement of the body's COM and (2) compensatory postural adjustments (CPA) that are initiated by the sensory feedback signals and used as a mechanism of restoration of the position of COM after a perturbation has already occurred. The role of anticipatory postural control in maintenance of vertical posture as well as the relationship between the anticipatory and compensatory components of postural control will be discussed.



## **Sleep-related enhancement consolidation in motor skill learning - moving beyond the SRTT-paradigm**

**Klaus Blischke, Andreas Manalgré**  
Saarland University, Saarbruecken, Germany

Sleep is known to elicit off-line improvements of newly learned procedural skills, a phenomenon which is attributed to enhancement consolidation (EC) of an internal skill representation. In the motor domain, EC has been reported almost exclusively for sequential finger-tapping skills (SRT, DSP, finger-to-thumb movements), while evidence that these findings might generalize to a broader realm of motor tasks appears to be rather limited at best. Nonetheless sleep-related EC has been – and is now increasingly - reported by different authors for motor tasks other than the typical SRTT. Such tasks are either closer to everyday motor skills and more demanding than the SRTT in terms of movement production in that they require redundancy control (i.e. gross motor tasks; reaching movements in two- or three-dimensional space), or in that they explicitly address the relative timing (“rhythm”) of movement sequences, or in that they even extend the notion of EC to mental practice procedures. Although some of these results may not be regarded as being unequivocal in every respect yet, altogether these recent studies might offer additional insight into the boundaries within which EC can impact procedural skill acquisition and retention.

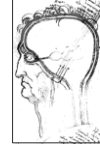


## **Aging, motor output variability and learning novel motor tasks**

**Evangelos A.Christou, Tanya Onushko, Fox E.J., Baweja H.S., Kwon M.H., Chen Y.T., Kim C., and Larkin K.**

University of Florida, Neuromuscular Physiology Lab, Department of Applied Physiology and Kinesiology, USA

Our recent data clearly demonstrate that transfer is impaired in older adults, which reflects impaired motor learning. In addition, we found that greater motor output variability during task acquisition inhibits the ability of older adults to transfer motor tasks. **Purpose:** We performed two intervention experiments to determine whether we can enhance motor learning in older adults. The first study manipulated visual feedback, whereas the second study manipulated task difficulty. We hypothesized that reduced visual feedback and lower task difficulty would enhance motor learning in older adults because it would decrease motor output variability during task acquisition. **Methods:** *Experiment 1:* Forty subjects were divided into low-gain (10 older adults) and high-gain (10 older adults) visual feedback training (5 sessions; 2 weeks) and a control group (10 young and 10 older adults). The task was to accurately match a sinusoidal target (0.6 Hz and 10° range of motion) by plantar-flexing and dorsi-flexing their ankle. Post-training, all subjects performed the task with abduction of index finger (transfer). *Experiment 2:* Thirty-five subjects (18 young and 17 older adults) were divided into an easy (0° phase) and a hard (90° phase) coordination training group and a control group (no training). The task was to accurately match the force template while subjects exerted concurrent force with the index and little fingers. Post-training, all subjects performed transfer tasks at different relative phases (45°, 135° and 180°). **Results:** *Experiment 1:* Motor output variability was ~20% less with reduced visual feedback during task acquisition. Transfer was greater for the older adults who trained with the low-gain visual feedback compared with the high-gain visual feedback and control group. This was evident by lower errors when subjects performed the task with the index finger. *Experiment 2:* Motor output variability was ~30% less with lower task difficulty during task acquisition. Transfer was greater for the older subjects who trained with the easy task compared with the hard task and the control group. This was evident by lower RMSE and temporal errors and lower force variability during the transfer tasks (45°, 135° and 180° relative phases). **Conclusions:** We demonstrate that training with reduce visual feedback and lower task difficulty enhances motor learning in older adults. These training protocols may be beneficial for older adults because they minimize motor output variability during task acquisition.

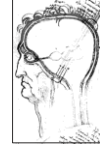


## **Plasticity and variability of motor unit contractile properties**

**Jan Celichowski**

Academy of Physical Education in Poznań, Poland

In mammalian skeletal muscles the three main types of motor units can be distinguished. The contractile properties of these units are variable in relation to their physiological role. The lecture will summarize experiments concerning variability of motor units properties in frequently studied medial gastrocnemius muscle and their variability in two species, cats and rats, as well as experiments on differences of their properties in males and females. Moreover, plasticity of motor unit properties in rat medial gastrocnemius evoked by the spinal cord injury, will be reviewed and effects of two types of training, the treadmill locomotor and whole-body vibration training will be presented.



## **Contrasting views on human postural control**

**Marcos Duarte**

Federal University of ABC, Brasil

We are still far from a complete understanding of how exactly humans control their posture and many questions are yet to be satisfactorily answered. The goal of this talk is to present some of the knowledge of how humans control their posture during standing, with a particular focus on the main theories and modeling of the postural control system. Some aspects of the main technique for quantification of the postural sway, the posturography, will also be addressed. By discussing a few of the debates in the study of postural control, I also hope to evince how active and intense the study of postural control is, and to suggest that much is yet to be done.



## **Grip force control in static manipulation tasks**

### **Slobodan Jaric**

University of Delaware, Department of Kinesiology and Applied Physiology, and Biomechanics and Movement Science Graduate Program, USA

Manipulation of hand-held objects arguably represents one of the most important motor activities in human daily life. According to a simple mechanical model, the force applied upon a vertically oriented hand-held object could be decomposed into the grip force (GF; the component perpendicular to the hand-object contact area that provides friction) and the load force (LF; the parallel component that can move the object or support the body). A number of studies have shown an overall high level of GF-LF coordination in variety of static and dynamic manipulation tasks. The same coordination can be partly reduced in particular motor tasks, as well as in populations known for impaired hand function. The aim of a series of our recent studies was to investigate the underexplored factors that could affect the GF-LF coordination in static manipulations. Among others, we explored the role of hand friction, effects of the patterns of LF change on the GF control, the possible role of instructions, and the effects of task complexity on the inter-limb and within-limb coordination. The observed findings not only revealed important phenomena associated with the force coordination and the associated neural control mechanisms, but could also contribute to the development of routine clinical tests of hand function.



## **Study on neuromuscular plasticity in humans related to disease and exercise**

**Anna Jaskólska**

Academy of Physical Education in Wrocław, Poland

Based on experiments conducted in our laboratory with dr. Claudio Orizio participation in one experiment and in laboratory of dr. Guang Yue (Cleveland Clinic, USA) with our group members participation

Our group selected published and unpublished yet results of experiments on central (motor command sources, muscle coordination, motor units strategy) and peripheral mechanisms of voluntary maximal and submaximal force production (development and relaxation) with different speed and their plasticity related to exercise and disease are presented. For such purposes we recorded and analyzed force/torque (voluntary and twitch), muscle-tendon unit stiffness (myotonometry), mechanical (MMG) and electrical (EMG) signals (time and frequency domain, and EMG spike analysis) of different muscles and brain electrical (EEG) signals (MRCP - motor related cortical potential amplitude, sources) and brain scan using echo planar imaging sequence (FC - cross-correlation based functional connectivity).

In summary our experiments indicate that (1) brain probably plans and programs movements for controlling muscle fast activation and deactivation differently from slow, gradual task, and it also controls synergist and antagonist muscles in relation to speed of tasks, (2) there is a more diffused pattern of cortical signals for deactivating than activating the muscle, (3) there is differential motor unit activities between the different tasks (slow-fast activation or deactivation) as a consequence of non-uniform cortical control signals for activating and deactivating the different heads of muscle (the quadriceps femoris), (4) during relaxation gradually motor units turn off decreasing EMG amplitude however individual MU are active till the relaxation end, (5) ECC-related muscle fatigue affects mainly the processes associated with force generation capacity but not those responsible for muscle relaxation and ECC repeated bout effect is evident for muscle stiffness and soreness, and twitch contractile properties but half relaxation time, (6) when muscle fatigue worsens, many brain regions increase their coupling to compensate for diminished force generating capability of the muscle in a coordinated fashion by enhancing the descending command for greater muscle recruitment to maintain the same force, (7) there can be changes in muscle and MU activation strategy in PD patients (because of higher muscle and tendon stiffness in PD than in healthy controls) that however can be attenuated by anti-parkinsonian medication (8) central nervous system fatigue plays a more important role in limiting performance of submaximal motor task in CRF than muscle fatigue, (9) poor reaching performance in stroke patients can result from weakened functional coupling between two synergists as a result of a loss of common drive at the low frequency bands (0 to 11 Hz) and interruption of information flow in the corticospinal pathway.

General conclusions: Relaxation/deactivation is an active process engaging even bigger brain areas than activation. Exercise and disease related changes in force production and motor coordination are accompanied by changes in brain regions



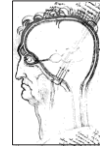


*International Scientific Conference*  
*Motor Control 2012 – From Theories to Clinical Applications*

---



activity, coupling among them, and changes in functional coupling between synergists and antagonists muscles that however medication (such antyparkinsonian) may compensate. Central fatigue is the main reason for performance of submaximal motor task limitation in cancer survivors with fatigue symptoms.



## **Movements that are both variable and optimal**

**Mark Latash**

Pennsylvania State University, USA

This brief review addresses two major aspects of the neural control of multi-element systems. First, the principle of abundance suggests that the central nervous system unites elements into synergies (co-variation of elemental variables across trials quantified within the framework of the uncontrolled manifold hypothesis) that stabilize important performance variables. Second, a novel method, analytical inverse optimization, has been introduced to compute cost functions that define averaged across trials involvement of individual elements over a range of values of task-specific performance variables. The two aspects reflect two features of motor coordination: (1) using variable solutions that allow performing secondary tasks and stabilizing performance variables; and (2) selecting combinations of elemental variables that follow an optimization principle. We suggest that the conflict between the two approaches (a single solution vs. families of solutions) is apparent, not real. Natural motor variability may be due to using the same cost function across slightly different initial states; on the other hand, there may be variability in the cost function itself leading to variable solutions that are all optimal with respect to slightly different cost functions. The analysis of motor synergies has revealed specific changes associated with atypical development, healthy aging, neurological disorders, and practice. These have allowed formulating hypotheses on the neurophysiological mechanisms involved in the synergic control of actions.



## **Movement and balance control limitations related to obesity**

### **Normand Teasdale**

Université Laval, Faculty of medicine, Department of kinesiology, Québec, Québec, Canada

Epidemic excess of weight is considered as a critical and common health problem. It is associated with many physiological and psychological disorders. Other than metabolic and psychological problems, obesity also affects the efficient execution of daily living activities such as the simple act of standing, walking or grabbing an object while standing. In this presentation, I will present a state of knowledge about the detrimental effect of obesity on postural stability. For instance, the association between obesity and reduced balance control has been consistently demonstrated, and obese adults (Hue et al. 2007), children (McGraw et al. 2000), and elderly (Dutil et al. 2012) generally oscillate at greater speeds than normal-weight individuals. It is also demonstrated that reducing body weight (via a weight loss intervention) improves balance control (Teasdale et al. 2007). As well, obesity has a detrimental effect on the speed and accuracy of upper-limb goal-directed movements when these movements are performed from a standing posture (Berrigan et al. 2006; D'Hondt et al. 2008) and not from a seated posture (Berrigan et al. 2008) suggesting the decreased performance of obese individuals has for origin balance constraints imposed by obesity. We have performed experimental tests to evaluate the role of muscular strength for standing balance control in obese individuals (Handrigan et al. 2010, 2012). The results of these studies showed that increased lower limb strength (and non-specific training) has little effect on standing balance control in obese individuals. This suggests that there may be other aspects of balance control that are affected by the added mass in obese persons. The cutaneous mechanoreceptors are capable of rapidly detecting changes in ground-reaction force angle and several studies suggest a significant contribution from the mechanoreceptors during standing balance control. A preliminary study suggesting that reduced balance control in obese individuals may result from a decreased sensitivity of the plantar sole mechanoreceptors will be presented.

#### References:

- Berrigan, F., Simoneau, M., Tremblay, A., Hue, O., & Teasdale, N. (2006). Influence of obesity on accurate and rapid arm movement performed from a standing posture. *International Journal of Obesity* (2005), 30, 1750-1757.
- Berrigan, F., Hue, O., Teasdale, N., & Simoneau, M. (2008). Obesity adds constraint on balance control and movement performance. *Human Factors and Ergonomics Society Annual Meeting Proceedings*, 52, 1364-1368.
- D'Hondt, E., Deforche, B., De Bourdeaudhuij, I., & Lenoir, M. (2008). Childhood obesity affects fine motor skill performance under different postural constraints. *Neuroscience Letters*, 440, 72–75.



- Dutil, M., Handrigan, G. A., Corbeil, P., Cantin, V., Simoneau, M., Teasdale, N., & Hue, O. (2012). The impact of obesity on balance control in community-dwelling older women. *Age*. In-press.
- Handrigan, G. A., Berrigan, F., Hue, O., Simoneau, M., Corbeil, P., Tremblay, A., & Teasdale, N. (2012). The effects of muscle strength on center of pressure-based measures of postural sway in obese and heavy athletic individuals. *Gait & Posture*, 35, 88-91.
- Handrigan, G., Hue, O., Simoneau, M., Corbeil, P., Marceau, P., Marceau, S., Tremblay, A., Teasdale, N. (2010). Weight loss and muscular strength affect static balance control. *Int J Obesity* (2005), 34, 936-942.
- Hue, O., Simoneau, M., Marcotte, J., Berrigan, F., Doré, J., Marceau, P., Marceau, S., Tremblay, A., & Teasdale, N. (2007). Body weight is a strong predictor of postural stability. *Gait and Posture*, 26, 32-38.
- McGraw, B., McClenaghan, B. A., Williams, H. G., Dickerson, J., & Ward, D. S. (2000). Gait and postural stability in obese and nonobese prepubertal boys. *Arch Phys Med Rehabil*, 81, 484-489.
- Teasdale, N., Hue, O., Marcotte, J., Berrigan, F., Simoneau, M., Tremblay, A., Doré, J., Marceau, S., Marceau, P. (2007). Reducing weight increases postural stability in obese and morbid obese men. *Int J Obesity*, 31, 153-160.



## Learning a complex visuo-motor task and balance control in older individuals

Normand Teasdale<sup>1,2</sup>, Simoneau<sup>1,2</sup> M., Tessier<sup>1</sup> J.-F., Gagné Lemieux<sup>1</sup> L., Blouin<sup>3</sup> J.

<sup>1</sup>Université Laval, Department of kinesiology, Québec, Canada,

<sup>2</sup>Vieillessement, Centre de recherche FRSQ du CHA universitaire de Québec, Québec, Canada,

<sup>3</sup>Laboratoire de Neurosciences Cognitives, Aix-Marseille University & CNRS, Marseille, France

Email: [Normand.Teasdale@kin.ulaval.ca](mailto:Normand.Teasdale@kin.ulaval.ca)

### Introduction

Mirror tracing leads to a conflict between the visual inputs and proprioceptive signals [1-3]. When first confronted with the task, healthy individuals have difficulties when changing directions and particularly when tracing oblique lines. Following several practice trials, subjects learn to resolve this conflict resulting in an improved performance, that is, less time is required to complete the task and the traced lines become straighter. There are suggestions that, while performing this task, subjects lower the gain of the proprioceptive inputs to adapt to the visual perturbation created by the inverted vision [1-3]. If learning to trace mirror-reversed patterns requires attenuation of proprioceptive signals, performing this task upright implies that the brain needs to attenuate proprioceptive signals from the upper arm but not those related to body sway to ascertain proper balance control. To examine this possibility, young and older healthy participants initially learned to trace a mirror pattern in a seated position. When transferring from the seated to an upright standing position, we postulated that, compared to young adults, older individuals would exhibit a decreased tracing performance. This result would suggest older individuals have a decreased ability to process sensory inputs from the hand and posture independently.

### Methods

Ten young individuals (3 males and 7 females;  $22.6 \pm 2.8$  yrs old) and eleven healthy older participants (8 males and 3 females;  $70.4 \pm 4.4$  yrs old) participated. The setup allowed seeing their hand and a six-pointed star template through a mirror only. The template was a double line pattern with each border separated by 7 mm (total path length = 54 cm). The participants first learned to draw with an ink-less stylus in a seated condition. After two 12-trial sessions on two consecutive days (each trial ended after tracing the star shape), they transferred to a standing condition (third day). An additional 12 trials in a normal vision condition was collected at the end of the third day. Pen and force platform (standing conditions only) data were analysed.

### Results

When seated, both groups learned the task even if young subjects showed a better performance than older individuals at the end of the second session, (total pen displacement: 60.4 vs. 66.2 cm,  $p < 0.05$ ; time to complete the pattern: 15.1 vs. 31.2 s,  $p < 0.05$ ). The performance for the last 6 trials of the second session was stable as no significant changes in the time needed to complete the pattern or total pen displacement was observed for both groups ( $p_s > 0.05$ ). Thus, by the end of the second seated session and compared to the initial trials, both groups showed a much improved and stable performance. Fig. 1 shows the tracing performance for the last three seated trials and the subsequent standing trials. While young subjects were not affected by the transfer to the standing condition, older participants

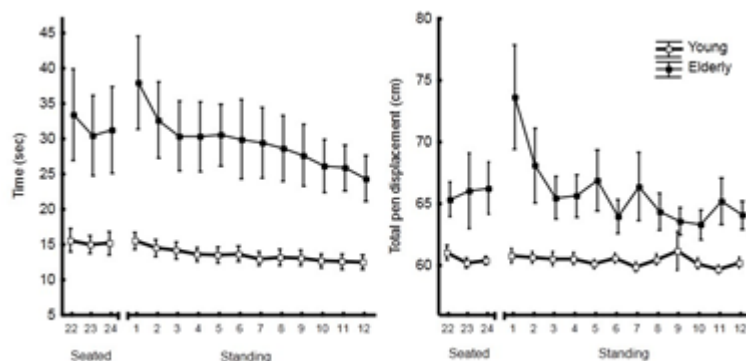


Figure 1: Mean (SE) time to complete the pattern and total path for the last 3 seated trials and the standing trials (mirror condition).



showed an initial increased time and total pen displacement. This increase was short lasting (two trials for the pen displacement and one trial for the time to complete the pattern,  $p < 0.001$ ). There was no group difference for the center of foot pressure (CoP) data ( $p > 0.05$ ). Both groups rapidly improved their performance with normal vision. For both groups, the CoP speed was smaller when tracing the mirror-reversed pattern than when tracing the pattern in normal vision (on average, 1.3 vs. 1.8 cm/s).

### **Discussion**

There are several suggestions that when subjects trace a mirror pattern from a seated posture, they attenuate the contribution of proprioceptive signals from the upper limb and increase the relative gain of the visual information. For instance, Bernier et al. [8] showed that the initial exposure to a mirror-reversed condition is accompanied by substantial proprioceptive suppression occurring in the primary somatosensory cortex (S1). Also, Balslev et al. [10] applied repetitive transcranial magnetic stimulation (rTMS) to the anterior parietal cortex in order to reduce hand proprioception. The stimulation resulted in immediate improved trajectory accuracy during mirror tracing. These studies suggest that a reweighting of the gain of the visual and proprioceptive signals contribute to learn the mirror tracing task. When tracing while standing, proprioceptive information from the moving arm and lower limbs is processed by the central nervous system. Young subjects showed no perturbation in their performance when transferring to the standing condition. On the contrary, older individuals showed a short lasting decreased tracing performance. Interestingly, balance control did not differ between young and older adults. This transient perturbation showed by older adults may result from a difficulty to process sensory inputs from the hand and lower limbs independently. According to this hypothesis, the brain would have released the sensory gating initially exerted over the entire proprioceptive system while standing to ensure efficient postural control. Such strategy would help preserve equilibrium but would increase the conflict between arm proprioception and vision (hence increase the tracing errors). The increased tracing performance that followed may suggest that sensory gating, more circumscribed to the cortical representation of the arm, developed rapidly in erected position. The parallel processing of proprioception for balance control and for a focal task might be a bigger challenge for older people [4].

### **References**

- [1] Lajoie Y et al. Mirror drawing in a deafferented patient and normal subjects: Visuo-proprioceptive conflict. *Neurology*. 42:1104-06, 1992
- [2] Bernier P-M et al. Direct evidence for cortical suppression of somatosensory afferents during visuomotor adaptation. *Cereb Cortex*. 19:2106-13, 2009.
- [3] Balslev D et al. Enhanced accuracy in novel mirror drawing after repetitive transcranial magnetic stimulation-induced proprioceptive deafferentation. *J Neurosci*. 24:9698–702. 2004
- [4] Mallau S, Simoneau M. Aging reduces the ability to change grip force and balance control simultaneously. *Neurosci Lett*. 452: 23-7, 2009.



# Poster Presentations



## **Reduced Dual Task Interference in Multiple Repeated Dual-Task Tests: Automatization or Task Integration?**

**Manfred Agethen, Daniel Krause**

University of Paderborn, Germany

The present study assessed two different explanatory appendages of how practice reduces dual-task interference. Extensive practice of a task pair can lead to different effects. On the one hand it can teach participants to efficiently integrate performance of a specific task pair and on the other hand it can promote automatization of individual tasks, which is characterized by reduced attentional demands in motor control (Ruthruff et al., 2006). Dual-task testing is widely accepted as a behavioral paradigm to assess automaticity of motor skills (Abernethy, 2001). But if Dual-Task Tests are multiple repeated, the resulting reduction of DTC can be caused by different mechanisms; automatization or task integration. The goal of the present study was to differentiate between efficiently integrated performances of a task pair as a consequence of multiple repeated dual-task tests and automatization of an individual task as a consequence of extensive motor skill practice between the tests. 10 subjects practiced an elbow-extension-flexion sequence with three movement reversals and should perform the task as precise and as fast as possible (460 trials; distributed over 6 sessions). Feedback for movement reversals and time was provided after every second trial. In pre-tests, at the beginning of each session and in one retention test, the movement task and a visual-spatial 2-back task were tested under single- and dual-task conditions (6 trials each) with instructed priority for the 2-back task (multiple-repeated). For testing context-unspecific DTC reduction, a transfer dual-task test (single-repeated: pretest and retention) with a visual-spatial Sternberg-task was conducted. The results indicate a context-specific reduction of DTC since the 2 (test: pretest; retention) x 2 (cognitive load: single-task; dual-task) ANOVA shows a significant interaction effect for the multiple-repeated 2-back test,  $F(1, 9) = 13.85$ ;  $p = .010$ ;  $\eta^2 = .61$ , while this is not the case for the respective ANOVA for the single-repeated Sternberg-test,  $F(1, 9) < 0.01$ ;  $p > .999$ ;  $\eta^2 < .01$ . Therefore reduced dual task interference in multiple-repeated dual-task tests should be considered with caution if automaticity is the construct of interest.





**The possibilities of clinical assessment of patients with Parkinson's disease after Deep Brain Stimulation (DBS) based on Motion Capture data. Preliminary results.**

**Magdalena Boczarska-Jedynak<sup>1</sup>, Stanisław Kwiek<sup>2</sup>, Bartłomiej Czechowicz<sup>1</sup>,  
Maria Flak<sup>1</sup>, Magdalena Stawarz<sup>3</sup>, Adam Świtoński<sup>3,4</sup>, Andrzej Polański<sup>3,4</sup>,  
Konrad Wojciechowski<sup>3,4</sup>, Andrzej Przybyszewski<sup>5</sup>, Grzegorz Opala<sup>1</sup>**

<sup>1</sup> Medical University of Silesia, Department of Neurorehabilitation, Department of Neurology, Katowice, Poland

<sup>2</sup> Medical University of Silesia, Department of Neurosurgery, , Katowice, Poland

<sup>3</sup> Silesian University of Technology, Institute of Computer Science, Poland

<sup>4</sup> Polish-Japanese Institute of Information Technology, Poland

<sup>5</sup> Department of Neurology, University of Massachusetts Medical Center, USA.

Deep Brain Stimulation (DBS) is the method of symptomatic treatment of selected Parkinson's disease (PD) patients. The evaluation of final effect of DBS is problematic, because subjective patient's assessment may differ from clinician's objective assessment. The aim of the study is the analysis of PD-DBS patients' motor ability based on Motion Capture (MOCAP) technology. PD patients after DBS, treated in the Department of Neurology and Department of Neurosurgery of Medical University of Silesia in Katowice, Poland are evaluated in Human Motion Laboratory in Polish-Japanese Institute of Information Technology in Bytom, Poland. Motion ability is evaluated in four conditions: 1. MedicationOFFStimulationOFF, 2. MedicationOFFStimulationON, 3. MedicationONStimulationOFF, 4. MedicationONStimulationON with MOCAP technology: using Vicon system with 10 NIR cameras and 39 reflective markers placed on body segments, Ground Reaction Force (GRF) with two Kistler platforms, Dynamic Electromyography System (EMG) and video recording of four video cameras with HD 1080. Neurologist evaluate motor symptoms with Unified Parkinson's Disease Rating Scale (UPDRS) part III. Six tasks are analysed: turnover, walking, sway ratio analysis on force platform, pull-test, leg agility, arising from chair. Gait coefficients were evaluated: gait velocity, stride length, ASA (Arm Swing Asymetry), ASS (Arm Swing Size), DI (Decompositon Index) and AST (Asymetry in Stride Time) to reflect asymetry of lower and upper limbs between left and right side during gait. Results were statistically analyzed. The preliminary results after examining first patient are presented. UPDRS part III scores were: MedOFFStimOFF-53; MedOFFStimON-23; MedONStimOFF-10; MedONStimON-8. All coefficients revealed significant improvement of motion ability and diminution of tremor when stimulator is ON. Analysis of DI showed statistically significant difference between MedOnStimON and two other sessions – MedONStimOFF and MedONStimON. These differences are joint specific and can be observed only for two pairs, knee vs ankle and ankle vs hip. Only sessions when patient was ON medications provide p-values < 0.05. We do not observe statistically significant changes in MedOFFStimON, but we notice improvement of motor skills in MedONStimON. In GFR evaluation, standing on one foot in MedOFFStimOFF evoked high frequency oscillations recorded by the platform, which were not observed in MedONStimON. The effect of medication and electrical DBS are



*International Scientific Conference  
Motor Control 2012 – From Theories to Clinical Applications*

---



complex and their interactions are not only side specific but they may be also a joint specific. Isolated DBS stimulation will not provide significant reduction in UPDRS scores as in DI. Only concomitant pharmacological and stereotactic treatment may have the most beneficial effect on patient's motor ability.

This work was supported by The National Science Center (NN518289240 A. Polański; NN516475740 K. Wojciechowski.), by the European Union from the European Social Fund (grant agreement number: UDA-POKL.04.01.01-00-106/09, M. Stawarz).



## **Functional limit of stability in relation to standing on inclined surface**

**Kristína Bučková, Zuzana Halická, Jana Lobotková, František Hlavačka**

Slovak Academy of Sciences, Laboratory of Motor Control, Institute of Normal and Pathological Physiology

The voluntary, maximum inclined posture reflects the self-perceived limits of stability. To investigate limits of stability in absence of external perturbation, the maximum voluntary inclined posture can be evaluated. The aim of this study was to investigate the effects of changing slope angle of support surface on voluntary limit of stability.

In the study participated 8 young healthy volunteers (2 male, 6 female, mean age  $26.1 \pm 0.9$  years, mean height  $171.1 \pm 1.2$  cm, mean weight  $62.7 \pm 3.1$  kg). Subjects stood on support surface with variable slope angle which was placed on force platform. Three dual-axis accelerometers (ADXL203) were placed on the fifth lumbar (L5), the fourth thoracic (Th4) vertebra and on the posterior aspect of the right thigh (RT). Participants were instructed to make a maximal voluntary forward inclination (using ankle strategy) after hearing sound signal (second sec after trial start) and persist in this position till trial end. Each trial lasted 10s and was repeated 3 times, under 6 conditions: eyes open – flat surface (EO\_S0), eyes closed – flat surface (EC\_S0), eyes open – slope angle  $10^\circ$  (EO\_S1), eyes closed - slope angle  $10^\circ$  (EC\_S1), eyes open – slope angle  $20^\circ$  (EO\_S2), eyes closed - slope angle  $20^\circ$  (EC\_S2). We evaluated the maximal displacement of CoP and amplitude of body segment tilts. Analysis of variance with 2-way repeated measures was used as a statistic method.

We observed that the lifting of surface slope angle up resulted in decrease of CoP displacement ( $p < 0.001$ ). Data from accelerometers placed at RT and L5 had a similar trends in decrease of amplitude ( $p < 0.01$ ) and data from Th4 accelerometer showed significant effect on amplitude reduction too ( $p < 0.05$ ). We also found out a significant influence of vision on amplitude in CoP and RT ( $p < 0.001$ ) and L5 ( $p < 0.01$ ). From Th4 data a significant effect of vision was not improved. Significant interaction was not also found between vision and support surface slope angle.

The present study showed that the functional limit of stability in forward direction is influenced by change of support surface slope angle. The decline of functional limit of stability could leads to higher risk of falls and injures. To determine limits of stability should be a suitable approach for analysing of balance control changes.

Supported by VEGA grant No. 2/0186/10



## **Effects of military exercises on joint position sense and injury in conscripts**

**Etemadi Yasaman Sadat<sup>1</sup>, Mohammadi Farshid<sup>2</sup>**

1. University of Social Welfare and Rehabilitation Science

2. KU Leuven, Faculty of Kinesiology and Rehabilitation Sciences,

The high incidence of lower limb injuries associated with physical exercises in conscripts suggests that fatigue may be one of the risk factors for injuries. It has been hypothesized that lower limb injuries may be related to altered ankle and knee joint position sense (JPS) as a consequence of fatigue. To evaluate if military exercises could alter JPS and to examine the possible relation of JPS to further musculoskeletal injuries in military service. 50 male conscripts from a unique base were randomly recruited. They performed 8 weeks of physical activities at the beginning of military course. Subjects were asked to recognize pre-determined positions before and after military exercises, to examine the effects of military exercise on JPS. The average of the absolute error (AE) and the variable error (VE) of three trials were recorded. The subjects were followed for 8 weeks and data on the frequency of lower extremity injuries were collected. Then the subjects were divided into two groups: injured and non-injured. Mixed model of analysis of variance (ANOVA) tests was used to determine main effects and interactions of these factors for each of the JPS measures. The second part of study examined whether the effects of fatigue on JPS were related to the development of injury during 8-week training program. Hedges' effect sizes (ES) were calculated for JPS changes following exercise in each group and change scores between groups were compared. There were significant group by time interactions for all JPS variables ( $p < .01$ ). All the participants showed significant increase in JPS errors following exercise ( $p < .01$ ), but the injured group had significantly greater changes for all the variables ( $p < .01$ ). Military conscripts who suffered a lower extremity injury during the course of an 8 week military exercise program had significantly greater loss of JPS acuity compared to those who did not sustain an injury. The changes in JPS may have predictive ability for further musculoskeletal injuries.



## **Strategy of safety during gait of the expectant mother**

**Wanda Forczek, Robert Staszkiwicz**

University School of Physical Education in Krakow, Poland

From a biomechanical perspective, progressive alterations in body shape, weight distribution may affect gravidas' pattern of walking. One can assume that the qualitative background of these changes is the ability of our species to natural adjust of the function of control system to a constantly changing external and internal environment. In these altered conditions the pregnant women may have potentially greater difficulty maintaining balance. Therefore, we expect, as pregnancy develops, a fear of postural instability may make the expectant mother more cautious. That is why, she is likely to employ a modified gait pattern reflecting her anxiety for both herself and her baby health. However, we know relatively little about safety strategy in gravid females. To carry out the study we used Vicon system. The inclusion criteria aimed at selecting only healthy women, planning a child in a near future. Considering different sizes of our individuals we engaged Froude number - the dimensionless speed corresponding to walking at optimal speed. Employing such criterion was a method to establish group of women with dynamic walking similarities. Kinematic data were collected from 11 females participated in 3 sessions: before pregnancy, in the last trimester of gestation (33 week) and half year after delivery. In terms of safety, we determined stability angles measured in two planes: sagittal ( $\beta$ ) and coronal ( $\alpha$ ) as well as the mean width of the base of support during double support phases. Generally, due to similar velocity, the spatio-temporal parameters of our subjects measured in successive states did not differ. However, differences were noted referring to the measures of safety. Different physiological state (pregnancy) affected the width of the base of support, which increased in gestation. At the same time significantly decreased the stability angle in sagittal plane and increased the angle in coronal plane. The mean values of both stability angles noted in PRE and POST state were similar. Undoubtedly pregnancy requires some compensation mechanisms within the body. Not only in terms of its adaptation to physical changes due to growing fetus and changes of mass distribution but also by mechanical alterations. Different technique of walking performed by gravidas seems to be their natural desire to maximize balance during movement. This thesis can be justified, at first by the tendency to maximize the width of the base of support during gait, secondly by increasing  $\alpha$  angle and, finally, by reducing  $\beta$  angle.



## **Effects of supplementary endurance training on postural stability in classical dancers**

**Artur Fredyk, Ewelina Smol**

Academy of Physical Education in Katowice, Poland

The classical dance is a physical activity requiring an excellent ability to maintain postural equilibrium. We hypothesized that short-term endurance training (E-TR), used as a supplement to the traditional dance schedule, improves the postural stability in the ballet dancers. To test this hypothesis, we evaluated the postural stability sway before and following a 6-week, low-intensity E-TR program in six adult ballerinas. All participants of this study were graduates of a state ballet high school and were active in their profession. The stability of upright posture was determined by measuring the amplitude in the center of foot pressure (COFP) excursion while performing motor voluntary task, including: quiet stance, forward-backward voluntary sway and rising on toes. Since the regulation of postural control is dependent on visual inputs, in all trials we analyzed postural stability with a full visual control (eyes open - EO) or without vision (eyes closed - EC). To secure participants' comfort and minimize the effects of fatigue or boredom there were some short breaks between each trial. The postural sway was recorded and analyzed with the Kistler force-plate. The signals from the platform were sampled at 100 Hz and stored at a PC class computer. The data collected during quiet stance were used to calculate the following parameters of COFP position: a total path length and their components: the length of path in both medio-lateral (ML) and antero-posterior (AP) direction. It was found that during the quiet stance both total and ML path length were higher after the E-TR in comparison to the pre-training levels of these indices, however these differences were statistically significant only for EC trials ( $p < 0.05$ ). There were no marked differences in indices of postural stability of dancers related to E-TR for leaning forward movement and rising on toes, with the exception of 3rd phase of rising on toes, when COFP was markedly increased after E-TR for EC trials ( $p < 0.05$ ). Conclusion: in the ballet dancers the introduction of supplementary E-TR to classical dance practice leads to a greater displacement in the ML direction and total trajectory of COFP during the quiet standing with the absence of visual control, suggesting a different pattern in management of static postural stability. Moreover, our data provide evidence of the important role of visual control in maintaining stability of upright posture in classical dancers.





## **The Reliability of Force Production Error in Healthy Individuals**

**Mariusz Furmanek, Kajetan Słomka, Grzegorz Juras**

Academy of Physical Education in Katowice, Poland

There are three major tests of proprioception described in literature; (1) reproduction of passive/active positioning, (2) threshold to detection of passive motion, and (3) force sense tests. The last one is studied the least, despite that it provides crucial information about proprioception system.

The purpose of this study was twofold; (a) to estimate the reliability of force production error and (b) to compare the errors made by healthy female versus male subjects when testing their dominant and non-dominant leg in perception of force produced at the knee joint. Fifteen healthy, young (8 female and 7 male) subjects were examined in this study. Neurological and/or orthopaedic conditions disqualified the potential participants. The Institutional Research Ethics Committee approved the study. The force production test consisted of twelve trials. First two were conducted in order to set the maximal isometric voluntary contraction (MIVC) of knee extensors. Then, each subject performed the remaining ten trials using only 50% of MIVC. The contraction and relaxation time lasted 5 and 15 second respectively. The Biodex System 4 Pro dynamometer was used to measure the force production. The dynamometer software provided the average peak torque (PT) over 5 sec. for each of the repetitions. The differences between the target torque (half of MIVC) and the average PT produced when considering absolute value (expressed in percentage value) was calculated and used for analysis.

A repeated-measures analysis of variance (ANOVA) showed no significant differences between genders  $F(1, 13)=0.458, p=0.510$ , and no significant differences between dominant and non-dominant knee  $F(1, 13)=0.012, p=0.913$ .

The average absolute force production error was 17.1% and showed no dependence on gender or dominant/non-dominant site. Results show that five trials are enough in order to assess the force production error  $ICC_{(2,1)}=0.95$ .

**Keywords:** force perception, force production error, proprioception, reliability, knee



## **Fine motor control and indicators of school readiness 6 years old children**

**Bogusława Gierat**

Academy of Physical Education in Katowice, Poland

Aspects of development that are considered to be critical indicators of preschool children's degree of school readiness has traditionally focused on cognitive and behavioral characteristics. However, many experts, mainly clinicians underscore the importance of motor development to kindergarten preparedness. (Case-Smith, 1998; Carlton & Winsler, 1999; Kurdek & Sinclair, 2000). Among the child characteristics associated with school adjustment, fine motor control has been suggested as a significant predictor of academic adaptation. (Case-Smith, 1998; Carlton & Winsler, 1999; Kurdek & Sinclair, 2000). This indicates the need for search in this terms some clues that might correlate with aspects that are considered to be critical indicators of the children's degree of school readiness. Better understanding of how the distinct key elements of school readiness relate to each other can help devise more comprehensive strategies in helping children become prepared to meet the challenge of the program of education and teaching. The purpose of this study was to explore the relationship between indicators of school readiness and coordination competence in terms of speed and accuracy in 6 years old children. Twenty-nine children from three randomly selected public kindergarten classes were recruited for the study. Children's age was from 6.2 to 7.4. School readiness of preschool children was evaluated with the use of the Education Diagnosis Tool for 6-7 years old children (Tryzno 2006). EDT verifies: skills of visual analysis and synthesis, hearing-language skills, graphomotor skills and preparation for mathematics. Movement coordination were diagnosed using the battery of 4 tests: Viena Determination Unit, Two-Hand Test, Pursuit Test, Computer Reaction Time Test. Statistical analyses were performed using the Pearson' correlation and canonical analysis. The correlation analysis for the whole group showed that the choice reaction time, hand coordination and space orientation correlates moderately with the school readiness variables . The results of canonical correlation analyses pointed to a tendency of development of abilities which define the readiness for beginning school and general coordination development in preschool children. Statistical significance and positive correlation between the set of motor variables and the set of school readiness variables, suggest to give more attention to coordination exercising in preschool age. In such a way small children will develop their motor and cognitive components of motor behavior, what will contribute to children's readiness for school.





## **The effect of externally added movement amplitude variability on motor learning**

**Mei-Chun Guo, Ing-Shiou Hwang**

National Cheng Kung University, Institute of Allied Health Sciences, College of Medicine

Based on motor control models, there are two loop systems available in the process of motor learning, closed-loop and open-loop system. The former relies on feedback to modify movement error, while the latter lean to a stimulus cue to invoke response-chaining reaction. Movement variability is produced through the learning stage, which is considered as a reflection of the degree of noise in cognitive sciences. Nevertheless, the postmodern branch thought the movement variability is a functional unity, with that, we explore the boundaries of stability and form perceptual information to increase adaptability and transferring within system. What if the provided feedback is unreliable and the previous experience is not abundant enough, would the motor skill be acquired and which pathway does the control system rely on? This experiment would like to investigate the difference of skill-acquired processes between normal visual feedback and interfered visual feedback. How does the noise adaptation works out to influence the performance? Twenty-four healthy volunteers were recruited and randomized to control and experiment group. They were required to do a discrete prehension task by thumb and index (dominant hand) pressing through a load cell according to the auditory stimuli. The manipulated variable is the provided visual feedback (correct or interfered). The first 3 trials were considered as pre-practice phase, the next 6 trials were practice phase, and the last 3 trials were post-practice phase. Behavior data, including normalized force error (NFE), variability of matching error, reaction time (RT), time to force peak (Tpk), and force impulse variability was analyzed. Two-way repeated measures ANOVA were used to compare the difference of group effect (control, experiment) and practice effect (pre, post). Paired-t test was used as post-hoc. A significant level of .05 was adopted. Normalized force errors showed a significant decrease in both groups ( $P < .001$ ). Variability of matching error showed similar pattern to NFE, with a notified decrement in post phase ( $P < .001$ ). After practicing, both groups didn't have better performance in RT and Tpk. Nevertheless, the interference group had obvious shorter Tpk than control group in pre and post phases. The variability of force impulses presented no difference between groups and phases. The added interference with matching-force amplitude seemed not influence the practicing effect. The experiment group adapted to the interference and achieved the better performance. The significant shorter Tpk and similar RT indicated the changes come from the movement execution time.



## **How visual biofeedback magnification affects upright stance**

**Zuzana Halická, Jana Lobotková, Kristína Bučková, František Hlavačka**

Slovak Academy of Sciences, Laboratory of Motor Control, Institute of Normal and Pathological Physiology, Slovakia

Postural sway can be reduced when real-time visual biofeedback (VBF) of the centre of pressure (CoP) position is provided. Further reduction occurs, when VBF is magnified. The purpose of this study was to determine the optimal magnification of the CoP position displayed on monitor.

Twenty healthy young adults (9 men; mean age 26,5 years) participated in the study. The body sway was recorded by force platform as CoP. The balance was assessed during quiet stance in 10 conditions: stance with eyes open on firm / foam surface and stance on firm / foam surface with additional VBF presented at 4 magnifications (Gain1, Gain2, Gain5, Gain10). VBF was presented as moving red point on monitor controlled by CoP positions from a force platform. We evaluated 6 parameters of CoP: amplitude and velocity in anterior-posterior ( $A_y$ ,  $V_y$ ) and medial-lateral ( $A_x$ ,  $V_x$ ) directions, root mean square (RMS) and line integral (LI).

Providing of VBF led to reduction of postural sway during the stance on both types of support surface. ANOVA revealed significant effect of gain in parameters  $A_x$ ,  $A_y$  and RMS. A significant effect of surface was found in all measured parameters. Also a significant interaction between surface and gain was observed in all parameters except  $V_y$ . Pairwise comparisons performed on each type of surface showed decrease of parameters  $A_x$ ,  $A_y$  and RMS during all VBF conditions except  $A_x$  on firm surface. Decrease of these parameters was also observed in VBF situations with greater magnifications comparing to lower magnifications. Velocity of body sway and LI did not change significantly.

Our results suggest that any magnification in range 1x-10x provides meaningful additional information and is helpful for postural stabilization in young healthy population. Greater magnification led to greater reduction of body sway amplitudes and RMS. Amplitudes of body sway and RMS seem to be the most appropriate parameters to test the effectiveness of additional visual biofeedback. Standing on foam surface led to a greater decrease of these parameters. This suggests a marked reliance on vision to maintain balance in situation when the proprioceptive information from feet is altered. Velocity and line integral of CoP did not show any increase which would suggest the voluntary activation in postural control. It is possible that other type of strategy (f.e.: arousal of attention) is involved in the process of postural stabilization.

Supported by VEGA grant No. 2/0186/10



## **The method of hurdle runs' teaching and the results of special field tests and laboratory tests.**

**Janusz Iskra, Jarosław Gasilewski, Jolanta Hyjek**

Academy of Physical Education in Katowice, Poland

State School of Higher Vocational Education in Racibórz, Poland

Hurdle run of a prolonged distance (150 – 400 m) is an athletic event that requires the ability to clear the hurdle with the right as well as the left leg. The goal of the study was the evaluation of changes caused by the two ways of teaching of the hurdle runs. Material and method. Two groups of physical education students (group A: n=14, age=20.0 years, BH=172.3 cm, BW=66.9 kg; group B- as follows: 19.6 years, 171.9 cm, 71.4 kg) participated in the process of teaching hurdle race with the use of different methods. In five-week-long period of time, the A group performed classic exercises of hurdle teaching methodic (Iskra 2000), using both legs as the leading one; B group cleared hurdles only with right leg. The test in 150 hurdle run (10 hurdles with 12 m inter-hurdle spacing) as well as a test with the use of Opto Jump (produced by Microgate from Bolonia) was conducted before and after the experiment. During the hurdle race, the following elements were evaluated: the time of the race, inter hurdle steps and the laterality factor - LF (Williams and Norris 2007). In the field test there were average results of 4 parameters used (time of contact phase -  $t_{cont}$ , flight phase time -  $t_{flight}$ , the height of the jump -  $h$  and the frequency of jumps -  $f$ ). All these parameters were assessed during the assisted and unassisted phase. Results. Before the start of the experiment there were no significant differences in the above mentioned parameters. After the experiment of teaching the hurdle run, the differences among the two groups were significant in WL - group B used right leg as a leading leg more often. In group B the authors also noticed a shortest time of a flight phase ( $t_{flight}$ ) in both phases, longest contact time ( $t_{cont}$ ) as well as smaller jump ( $h$ ) in the unassisted phase. Conclusions. The method of teaching hurdle runs significantly influences the effects of this education. The use of Opto Jump test in the control of teaching hurdle runs is not clearly stated and needs further researches.



## **Twitch contractile properties after two bouts of eccentric exercise of the elbow flexors muscles**

**Damian Janecki, Jarosław Marusiak, Renata Andrzejewska, Anna Jaskólska, Artur Jaskólski**

Academy of Physical Education in Wrocław, Poland

The purpose of this study was to assess if the protective adaptation after eccentric exercise affects also changes of twitch contractile properties of the biceps brachii muscle.

A within-group repeated measures design was used to determine changes in twitch contractile properties after two bouts of eccentric exercise separated by 2-3 weeks. Each bout of eccentric exercise that consisted of 30 repetitions of lowering a dumbbell adjusted to 75% of each individual's maximal isometric torque of the right elbow flexors. The second bout of eccentric exercise was performed when the subjects were able to develop the MIT at least at 90% of the pre-ECC value. Maximal isometric torque (MIT), twitch contractile properties, muscle soreness and relaxed elbow angle (RANG) assessments were measured in twelve untrained, right handed male volunteers (age  $23 \pm 2$  yr, height  $182 \pm 5$  cm, mass  $75 \pm 7$  kg) before, immediately after, 24, 48 and 120 hours following eccentric exercise.

The ECC1 reduced peak twitch torque (PT) from  $22.4 \pm 6.9$  Nm to  $12.3 \pm 4.9$  Nm,  $13.4 \pm 5.8$  Nm,  $14.4 \pm 6$  Nm for immediately after, 24 and 48 h after eccentric exercise respectively (mean  $\pm$  SD;  $P < 0.05$ ). The ECC2 caused a significant decrease PT immediately after exercise only (from  $20.9 \pm 6$  Nm to  $13.9 \pm 4.2$  Nm; mean  $\pm$  SD;  $P < 0.05$ ). Moreover the values of PT in all measurements performed from 24 h after ECC2 were significantly higher ( $P < 0.05$ ) where compared to respective time points after ECC1. Maximal rate of twitch torque development (RFD) decreased from  $875 \pm 261$  N m s<sup>-1</sup> to  $497 \pm 155$  N m s<sup>-1</sup> immediately after eccentric exercise and remained significantly lower ( $P < 0.05$ ) up to 120 h after ECC1. The value of RFD after ECC2 decreased significantly immediately after exercise only (from  $794 \pm 257$  N m s<sup>-1</sup> to  $554 \pm 180$  N m s<sup>-1</sup>) and was significantly higher in all measurements performed from 24 h after ECC2 where compared to respective time points after ECC1. There were no significant ( $P > 0.05$ ) changes in half relaxation time between bouts and measurement time after ECC.

The findings indicates that specific muscle damage after ECC affects mainly the processes associated with force generation capacity but not those responsible for muscle relaxation. Therefore, repeated bout effect is evident for twitch contractile properties such as peak torque and rate of torque development but not for half relaxation time.



## **Efficiency during cycling: the effect of altered pedaling speed on muscle activities**

**Peter Katona, Jozsef Laczko**

Semmelweis University, Dept. of Biomechanics

We are working on functional electrical stimulation (FES) assisted lower limb cycling for spinal cord injured (para- or tetraplegic) patients. We use this training method to get the beneficial effects of physical activity on the muscles and joints of the lower limbs locally and on their whole body (cardio-vascular system, respiratory system). The applied stimulation patterns are based on measured muscle activities of able-bodied individuals. If cycling speed expected to be increased or cycling against higher resistance is desired than stimulation patterns must be changed. In this study the effect of change of cycling speed on activities of knee flexor and extensor muscle groups in different load conditions is investigated during cycling movements of young healthy individuals (41). The subjects performed cycling movements on a recumbent bike with slow (45rpm) and fast (60rpm) speed in three load conditions (low, moderate and high) while surface EMGs of quadriceps and hamstrings muscle groups were recorded using the ZEBRIS CMSP70 (Isny, Germany) movement analyzing system. The sampling frequency was 1000Hz. About 15 seconds were recorded in each load condition for slow and fast movements as well. The comparison of EMG data measured during slow and fast cycling was performed after filtering (Butterworth filter with cutting frequencies of 50 and 400 Hz.) and smoothing (by RMS) the data. The change of (average) EMG amplitudes as an effect of speed change has been examined separately for the three load condition. In low and high load condition the rate of change of the mean EMG amplitude did not differ significantly for the two muscle groups. In moderate load condition the rates did not differ significantly either but this difference almost reached significance level ( $p=0.07$ ) and it was larger for hamstrings than for quadriceps muscles. We assume – based on these preliminary results – that there is an optimal load condition where the speed is controlled mainly through the activity of hamstrings muscle group, the main power producer is still the quadriceps group. This observation may lead to adequate stimulation patterns for SCI patients if they are expected to perform faster cycling against various crank resistances.



## **Fifteen minute treatment with low frequency, high intensity transcutaneous electrical nerve stimulation (TENS) increases maximum**

**Sohit Karol, Jae Kun Shim**

Harvard School of Public Health, USA

The purpose of this study was to investigate the effect of transcutaneous electrical nerve stimulation (TENS) treatment on maximum voluntary force (MVF) production. Ten healthy, young subjects (5 males and 5 females) participated in the study. MVF was recorded after a fifteen minute session of TENS stimulation under two conditions: low frequency (4Hz) at maximum tolerable level and high frequency (110Hz) at maximum tolerable level. TENS was provided simultaneously via self-adhesive electrodes placed on the finger pads of the index, middle, ring and little fingers. MVF was also recorded in a baseline condition with no TENS treatment. Data were collected in three different sessions on three consecutive days at the same time of the day. Results from the study show that on an average, MVF increases by 25% for the index, middle and little fingers for TENS treatment with 4Hz frequency as compared to the baseline condition. However, the 110Hz condition did not result in a significantly different MVF than the baseline condition during individual finger pressing tasks. In addition, while producing MVF with all the four fingers together, MVF was 30% higher for the 4Hz condition in comparison to the baseline condition, and 15% higher for the 110Hz condition in comparison to the baseline condition respectively. The results suggest that stimulation of afferent fibers on the glabrous skin with TENS could have a net facilitatory effect on the maximum motor output.





## **The influence of whole-body cryostimulation on muscle regeneration after intensive physical exercise**

**Magdalena Kępińska, Zbigniew Szyguła**

University School of Physical Education, Krakow

The body's response to low temperature is manifested by positive changes in the hormonal system, circulatory, nervous and immune system, it has a significant impact on the mechanisms of regeneration and tissue mobilization. Cold therapy is increasingly used for rehabilitation and treatment, and in biological regeneration, and the previous studies confirm its positive impact on the human body. The analgesic, anti-inflammatory and anti-swelling impact of cryotherapy is currently used to treat rheumatoid diseases and to assist the primary treatment. This kind of treatment is also used in sport to increase exercise tolerance and endurance, improve the perception and concentration, as well as the prevention of DOMS (delayed-onset muscle soreness). Cryotherapy is increasingly included in the wellness treatments. It is also used in rehabilitation of chronic rheumatic and posttraumatic injuries of movement organs, and in preparation of the active players in sports for the effort. Particular importance of this form of healing therapy is associated with analgesic, anti-inflammatory and anti-oedema effect. Cold therapy inhibits inflammation by decreasing the activity of inflammatory mediators. Analgesic effect of cryotherapy is attributed to the action of  $\beta$ -endorphin - neuropeptide, whose concentration in serum is higher after the treatment. Repeated cryotherapy treatments also reduce levels of creatine kinase (CK), lactate dehydrogenase (LDH) and the production of proinflammatory cytokines (IL-2, IL-8) and cause the increase of circulating anti-inflammatory cytokines (IL-10). It was also observed that after cryotherapy treatments the level of interleukin 6 increase and it causes also the increase of cortisol in plasma. These changes contribute to the acceleration of recovery from muscle damage caused by intensive exercise. The procedures of whole-body cryotherapy differ in particular study, the number of examined people is low, the variability in gender and age occur, blood samples are collected in various periods of time and the temperatures in cryogenic chamber are also changeable. That's why the goal of the review is to introduce literature about the influence of whole-body cryotherapy on muscle regeneration after intensive physical exercise.



## **The changes in chosen aspects of motor coordination in girls aged 16 years – a preliminary results of one decade study (2002 – 2012)**

**Małgorzata Kozłowska<sup>1</sup>, Beata Juras<sup>2</sup>, Grzegorz Juras<sup>2</sup>, Joachim Raczek<sup>2</sup>**

<sup>1</sup> Pedagogical University of Cracow, Institute of Geography, Faculty of Geography and Biology, Poland

<sup>2</sup> Academy of Physical Education in Katowice, Poland

The results of different research illustrate a tendency in changes in physical activity and motor fitness of different populations. In general, it could be stated that most of them are focused on aerobic endurance and maximal power. Results of these experiments, in general, show the significant decrease in motor abilities. However, there is a lack of results of longitudinal studies on motor coordination and different aspects of motor performance associated with precise and fast movements. Simultaneously, it is well known that motor coordination is important because of its crucial role in every human activities and increasing demands of contemporary life. The main aim of the study was to estimate the tendency in changes in chosen aspects of motor performance associated with motor coordination in 16 years old girls. The research was conducted on 67 girls aged 16 years from the Subcarpathia's county. That age was selected first because motor performance of 16 years old girls from a variety of samples reaches a plateau and even declines during adolescence. Control group consisted of 168 girls of the same age from the same region. The data was collected in year 2002 as a part of international research project "Motorische Entwicklung in der Lebensspanne". First, basic somatic parameters were measured. Next, field tests were used to estimate chosen aspects of motor coordination: precise coordination (*balance walk on the gymnastic bench*) and fast coordination (*10 seconds side step-test*). There was no significant difference noticed in body height in compared groups ( $p > 0,05$ ). Results of measurements conducted in 2012, showed that these girls have significantly bigger body mass. According to the results of one-way ANOVA, girls which have been measured in 2002 achieved significantly better results than girls from the other group in both conducted trials describing precise and fast motor coordination ( $p < 0,05$ ). The continuation of longitudinal researches of the state of physical and motor development in the context of secular trends seems to be necessary. Conducting future researches in children, youth and adults seems to be important to do next. Decreasing of any aspects of motor abilities, if sustained, should most likely reflect changing emphases in physical education instructions. It is also interesting to investigate the changing expectations and acceptance of that changes. Based on opinions many research, only 20 percent of children used to exercise anything in their leisure time, but computer games (including for example a modern Wii platforms) are still the most attractive ways of activities. Unfortunately,





*International Scientific Conference*  
*Motor Control 2012 – From Theories to Clinical Applications*

---



according to results of that study, these computer games seems not to be equal to physical activity in any aspect.



## **Flexion withdrawal reflex in multiple sclerosis: therapeutic use for stair climbing. A case report**

**Carmen Krewer, Jochen Quintern**

Schoen Klinik Bad Aibling, Germany

At the beginning of the 20th century, Sherrington assumed that the flexion reflex (FR) and the crossed extension reflex could be involved in the generation of reciprocal alternating limb muscle activation for locomotion (Sherrington, 1910). The FR is a polysynaptic and polysegmental spinal reflex that induces a complex flexion synergy of a stimulated limb. The various types of afferents which can evoke a FR have been called “flexor reflex afferents” (FRA) (Eccles & Lundberg, 1959). According to data from animal experiments the FRA include mechanoreceptors and pain receptors in the skin (Schomburg, 1990). The purpose of this case report is to demonstrate how this theoretical principle might be used as a therapeutic option in the rehabilitation of stair climbing. In two patients with multiple sclerosis (MS) a FR was elicited by electrical stimulation with surface electrodes placed on the lateral to medial aspect of the knee joint. Following stimulation parameters were used: frequency 35 Hz, pulse width 250  $\mu$ s, amplitude adjusted to release a FR below the pain threshold. Patient 1, a 50 year old man, had a monoparesis of the right leg with an EDSS (Expanded Disability Status Scale) score of 3.5. MS was diagnosed 25 years ago. He has a relapsing remitting MS without symptoms in the first 20 years after the diagnosis. Patient 2, a 54 year old man, had right-side accentuated tetraparesis with an EDSS score of 6.0. MS (with primary progressive aetiopathology) was diagnosed 10 years ago. Without the FES application both patients used a compensatory step-by-step stair ambulation pattern (placing both feet on the same step) to ascend the stairs. Stimulating the FRA to facilitate voluntary flexion at the hip, knee and ankle joints both patients were able to climb stair using a step-over-step ambulation pattern (contact each step with alternating feet). This case report describes an easily applicable therapeutic intervention in which a single-channel electrical current is used for FRA stimulation. These results suggest that this may be an alternative therapeutic option to facilitate stair climbing and possibly enhance the recovery of ambulation in selected patients with MS.



## **The influence of base of support perturbation on limits of stability**

**Patrycja Kołacz, Rafał Zając, Krzysztof Szydło, Kajetan Słomka, Grzegorz Juras**  
Academy of Physical Education Katowice, Poland

The main aim of this study was to determine the effect of the height on postural stability. The authors attempted to determine the effects of different conditions (height) on postural task performance during the functional balance test. Based on literature it is known that postural control is carried out differently, depending on the conditions of a task performance.

This issue has been examined and described only in relation to measurements of quiet standing tests, and there is lack of data addressing other types of tests (i.e. functional tests). The study was conducted on 15 students of the Academy of Physical Education who were not practicing any sport professionally. In the experiment was used the standardized measurement protocol of the LOS test which was carried out on the force platform (AMTI Accugait). LOS test consists of three phases: 10s of quiet standing, next the maximal forward leaning in a self paced manne and about 18s of maintenance of maximal forward leaning position. Participants were asked to perform LOS test twice in each task condition. There were four task conditions: forward lean with eyes open on the force platform placed on the ground level (LO) and on the platform placed 90 cm above the ground at the edge of the surface (HI), LOS test with eyes closed on height LO and HI. The same sequence was performed with backward lean.

A between subjects analysis of the effect of surface height on postural control revealed that was no significant main effect on the value of the maximum lean forward and backward. Also the results demonstrated there was no significant effect between eyes open and closed on the recorded amount of variables in LOS test on LO level and HI level.

**Keywords:** *limits of stability, dynamic balance, surface height*



## **Comparison of mechanical parameters of the vertical jump with varying load muscles in basketball players**

**Henryk Król**

Academy of Physical Education in Katowice, Poland

The aim of this study was to determine if the greater load in the expansion phase (eccentric muscle action) in the jump affects the size of the mechanical parameters of the jump. Thirteen young male basketball players participated in these investigations. The subjects performed tests that consisted of five, single “maximal” standing vertical jumps (counter movement jump – CMJ) and five, single vertical jumps, in which the task to be performed was to touch a bar placed over the jumping basketball players (special counter movement jump – SCMJ). Subsequently, they performed five, single drop jumps from an elevation of 0.40 m (DJ). Ground reaction forces were registered using the KISTLER 9182C force platform. MVJ software was used for signal processing (Król, 1999) and enabling calculations for mechanical parameters of the subject’s jumping movements (On-Line system). The obtained results show that the height of jump ( $h$ ), the mean power ( $P_{\text{mean}}$ ) and the peak power ( $P_{\text{peak}}$ ), are not statistically significant higher in DJ in comparison to CMJ. Drop jumps did not proved to be a more effective way to increase power output and jumping performance than other vertical plyometric exercises such as the counter movement jump in basketball players.

Key words: basketball players, dynamography, drop jump



## **Comparative analysis backward somersault tuck and piked**

**Henryk Król, Małgorzata Klyszcz-Morciniec, Grzegorz Sobota**

Academy of Physical Education in Katowice, Poland

This study is a pilot to a broader issue, which is to investigate the mechanism of take-off in tumbling. The research was conducted twice (December 2010, June 2011) on female gymnast (body mass 52 kg, and body height 161cm) in national championship class, with 13 years of training experience. Gymnast was been previously informed of the nature of research, and prior to their expressed written consent to participate.

The complex methodology of investigations was applied to study a movement structure on somersault backward. We have checked the usefulness of multi-modular measuring system (SMART, BTS, Company, Italy). This system includes six infrared cameras with a frequency of 120hz, modules for wireless measurement of bioelectrical activity of muscle Pocket EMG and force platform AMTI. Smart software (Smart Capture, Smart Tracker i Smart Analyzer) allows the modeling of spatial (3D) and the calculation of mechanical parameters. Large spatial accuracy is achieved by attaching the body of the test passive markers. After the system calibration accuracy of the distance between two markers in 3D was 0,4mm. Before performing the exercises specially prepared skin of the players at the mounting surface electrodes. Electrodes placed on sites of motor activation of muscles (in the direction of fibers), monitor the level of involvement of certain muscles (tibialis anterior, gastrocnemius, quadriceps, biceps femoris, gluteus maximus, erector spinae (pars lumborum), rectus abdominis, and deltoideus). Recorded vertical and horizontal components of ground reaction forces, and then determined their size in the characteristic moments of time. Using a comprehensive methodology in studies of the somersault backward, performed at two different positions (tucked and piked), allows the presentation of external and internal structure of the movement of this exercise.

In both studies, somersault backward piked compared to somersault tucked, required, at a lower flight altitude, higher angular momentum developed at the end of the take-off phase. Integrated electromyogram (IEMG) of eight muscles studies clearly characterized by high activity among the two of them gastrocnemius and erector spinae.



## **The influence of pilates exercises on the postural stability of young and older women - the comparison of effects of a short-term training**

**Lidia Kuba, Artur Fredyk, Izabela Zając-Gawlak, Joanna Kantyka**

Academy of Physical Education in Katowice, Poland

The subject of this study was the evaluation of the influence of the short-term Pilates training on the postural stability of young and older women. A fraction of women has been estimated in terms of the improvement and worsening of their postural stability caused by Pilates training. Furthermore, the training effects on improvement of postural stability in both groups of women have been compared. Fifty women, including twenty-two at the age of  $20.5 \pm 0.5$  years and twenty-eight at the age of  $59 \pm 5$  years have participated in this experiment. The experimental group consisted of healthy subjects only. Both young and older women participated in a three-month Pilates training program. The women exercised twice a week for one hour for three months. We used the force platform (AMTI, model BP6009000) to evaluate the subject's postural stability during quiet standing (closed base). The measurements were made twice: the first stage involved the measurement of starting parameters and the second one the evaluation of the same parameters after three months of practicing.

Prior to all calculations standard descriptive statistics had been performed. The influence of the 3 month Pilates training on the postural stability of the tested women was analyzed by means of the relative differences between the analyzed parameters with reference to the primary test. The level of significance was set at  $p < .05$ . The estimation of the fraction of women in whom an improvement or a decline in postural stability parameters occurred, was carried out on the basis of chi-squared test of independence. Analysis of variance with interactions was used to compare the effects of the training in both groups.

The research showed no statistically significant effect of the applied short-term Pilates training on the postural stability of the women studied. The percentage of improvement and decline of postural stability was different in both group of women. There were more cases of worsening than improving results by the older women, while by the younger ones, these values stayed at the same level. The effect of short-term Pilates training on the postural stability improvement by the young and the older women did not differ from  $p$  (test)  $> 0.05$ , however, the level of the postural stability was significantly higher among young women in both studies, a total of  $p$  (group)  $< 0.022$ .



## **Changes in fine motor behavior with age (based on visuo-proprioceptive and proprioceptive only feedbacks)**

**Liudmila Liutsko, Ruben Muiños and Josep Maria Tous-Ral**

University of Barcelona, Spain

The sample comprised subjects from the general population with normal or corrected-to-normal vision ( $N=196$ ,  $\text{age}=33\pm 21$  years, range: 12-95, men: 75%). Those individuals who had been forced to change their hand dominance at school were excluded from the study. The validated (Muiños 2008) computerized test (Tous and Viadé 2002; Tous, Viadé and Muiños 2007) was based on the original manual version proposed by Mira (1958) as a method of myokinetic psychodiagnosis (MKP). It comprised a tactile screen (LGE, resolution of  $1280\times 1024$ , optimal frequency of 60 Hz) in conjunction with a sensory stylus (for hand drawings), both of which were connected to a laptop computer (Pentium IV) on which was installed specially designed software for data coding and analysis (Tous 2008), and a piece of cardboard (or opaque screen) to hide the active arm and prevent the subject from receiving movement feedback. Fine motor behaviour, in the form of the precision of line lengths (tracing over 40 mm model lines) and task speed, was measured in the frontal and transverse directions for both hands and under two test conditions: proprioceptive information only (P) and proprioceptive + visual information (PV). Age was shown to have an influence on the precision and speed of fine motor performance under different test conditions, with the best performance being achieved at middle age and with a quadratic polynomial function providing the best fit for most of the variables. Inflection points (i.e. the critical age at which the graphical analysis showed the change in performance) ranged from 31 to 48 years old for the best fitting regressions in relation to precision, and from 36 to 40 in relation to time. For most types of movement analysed, performance speed was slower under the P condition. However, high and significant correlations were found between the mean times spent per movement under the different sensorial test conditions, especially in relation to frontal movements. As regards asymmetry of motor lateralization, the results showed that left-hand performance was significantly faster for some variables and some age groups; however, the precision was worse when the differences between L and R hands were statistically significant.





## **Step initiation: characteristics from accelerometry and camera motion capture system**

**Jana Lobotkova, Zuzana Halicka, Kristina Buckova, Frantisek Hlavacka**

Slovak Academy of Sciences, Laboratory of Motor Control, Institute of Normal and Pathological Physiology, Bratislava, Slovakia

Gait disturbances are among the more common problems in elderly. Gait initiation (GI) encompasses the preparation and execution of the first step. Important aspect of the beginning of gait is the anticipatory postural adjustments (APAs) reflecting the body's ability to predict the postural disturbances occurring with forward movement. Changes in GI may constitute particularly interesting early markers of neurological disorders. The purpose of this study was to determine the most sensitive kinetic and kinematic parameters of GI in young healthy subjects when taking short, normal and long steps. From a standing posture, 10 young adults (6 F; mean age  $27.3 \pm 1.2$  yrs) were instructed to initiate gait (several steps) in a forward direction after auditory cue. In trials, they walked at self-selected, shorter and longer steps. Foot reactions were measured at the initial stance using force platform and quantified by displacement of the centre of foot pressure (CoP) in the anterior-posterior (AP) and medial-lateral (ML) directions. Accelerations of upper and lower trunk were measured by two inertial MTx sensors (Xsens Technologies, B.V., Netherlands). Body segment motions were recorded with a 6-camera motion capture system (BTS Smart DX, Italy). Apart from CoP, we evaluated acceleration of upper trunk (sternum) and lower trunk (L5) in AP and ML directions, trajectories of markers placed identically and trunk angle in sagittal and lateral plane. In the process of step initiation, we differentiated between two phases – preparatory (APAs) and execution phase. As more sensitive parameter indicating the changes in APAs and also in execution phase of GI during the stepping in different step length conditions was CoP displacement in AP direction. Comparing the evaluation from accelerometers attached to sternum and L5, accelerations of upper trunk seem to be better indicators for assessment of postural changes during GI, in both AP and LR directions. In trunk angle and trajectories of sternum and L5 markers, APAs were not detected and changes during execution phase were not significantly different comparing short, normal and long step trials. Many studies present results from GI assessment only as CoP displacement and velocity. Our pilot study showed that analysis of step initiation from accelerometers on the upper and lower trunk and also 3D kinematic data could provide useful information for evaluation of changes in motor behaviour and strategies used during initiation of walking.

Supported by VEGA grant No. 2/0186/10





## **Postural stability changes after moderate effort in elderly depending on blood pressure**

**Janusz Maciaszek, Rafał Stemplewski, Wiesław Osiński**

University School of Physical Education in Poznań, Poland

The aim of the study was to assess a range of postural stability changes after moderate effort in elderly people depending on systolic blood pressure. The study included 27 men aged 65 to 81 years ( $71.6 \pm 4.9$ ). Subjects had their SBP measured in the sitting position. Postural stability was tested before the effort and directly after its completion. Postural sway (PS) during bipedal quiet stance was assessed. The shifts in vertical projection of the centre of pressure on the platform (COP) were collected using the AccuGait™ System posturographic plane (AMTI PJB-101 model, AMTI, Waterdown, MA). The following parameters related to COP sway were taken into consideration: Path length (mm) – total length of COP sway, Area95% (cm<sup>2</sup>) – sway area limited with an ellipse of the 95th centile. After the first measurement of postural stability the subjects carried out physical effort for 10 minutes on cycloergometer under a constant medical supervision. The level of intensity of the effort was established on the basis of heart rate (HR). The target values of training HR was calculated on the basis of the Karvonen formula (1957). The target value of training HR was calculated for 60% of VO<sub>2</sub>max. Our study of elderly men showed that rectilinear relation describes to a small extent the relations between SBP in rest and post-effort change in path length ( $R^2 = 5.3\%$ ) as well as between SBP and area95% ( $R^2 = 10.8\%$ ). The relations between resting SBP and change in postural stability after effort are curvilinear and adopt the shape of a parabola. Relations described in this way have the value of  $R^2 = 24,1\%$  for the relation between SBP and path length and  $R^2 = 36.4\%$  for the relation between SBP and area95%. Using only methods of determining straight relations in statistical analyses may lead to significant simplifications and to drawing biologically wrong conclusions which have serious practical consequences. The smallest post-exercise changes in postural stability are noted in people with resting SBP  $\approx 130$  mm Hg. Lower or higher values of SBP are related to the risk of increasing the path length and area95%, that is temporary decrease in postural stability.



## **ARNI training may affect levels of Activity and Participation in stroke survivors**

**Amir A. Mohagheghi, N. Theis, M. Norris, C. Kilbride**

Brunel University, United Kingdom

Despite evidences for the benefit of exercise after stroke, access to formal rehabilitation beyond 6 months is limited. Community based programmes have been initiated but currently there is insufficient evidence about their impact (Mead and Bernhardt, 2011). ARNI (Action for Rehabilitation from Neurological Injury) is one such programme. ARNI includes a set of functionally-oriented activities involving physical exercises for aerobic endurance, strengthening, range of movement, balance, and coordination; it is characterised by addressing motivation, and exploring attitudes and beliefs of the trainees. To examine the impact of a 12-week ARNI community based training on measures of impairment, activity, and participation. A pragmatic mixed-method was employed. Fourteen participants volunteered (age range: 19-82 years; 6 months-14 years post stroke). The participants received trainings in groups delivered by ARNI instructors once per week for 1.5 hours for 12 weeks. The participants were instructed to carry on with training at home and be creative with their own exercise. Maximum isometric voluntary contraction (MIVC) of the knee extensor and flexor groups and centre-of-pressure (COP) based measures of postural steadiness during quiet standing were used as measures of impairment. Activity was assessed using Berg Balance Scale (BBS) and 10 meter walking speed. The Subjective Index of Physical and Social Outcome (SIPSO) measured participation in everyday life. Measurements were obtained at baseline, after termination of intervention, and 12 weeks follow up. MIVC and COP-based measures of postural steadiness did not alter significantly. BBS showed a significant improvement ( $F(2,11) = 10.63$ ;  $p < .002$ ) in all participants which was more than the Minimal Detectable Change (MDC) for chronic stroke. The 10 meter walking speed improved in nine out of eleven participants, but the effect of training on walking speed was not significant. The improvement from baseline to post training session was significant at  $p = .03$  on a 1-tailed sign test. The SIPSO scores indicated a significant improvement overall  $p = .044$ . However when considered independently, the physical and social subsections did not alter significantly. This was the first study to assess the impact of ARNI training on stroke survivors. A significant improvement in activity and participation was seen regardless of age and levels of impairment, indicating a positive benefit of the ARNI training. The apparent lack of correlation between measures of impairment and Physical and Social components of SIPSO with those of activity supports a nonlinear association between different aspects of health after stroke.



## **EMG signal analysis the mvc test before and after functional testing in patients with gonarthrosis**

**Karina Nowak<sup>1</sup>, Grzegorz Sobota<sup>1</sup>, Bogdan Bacik<sup>1</sup>, Grzegorz Hajduk<sup>2</sup>  
Damian Kusz<sup>2</sup>**

<sup>1</sup>Academy of Physical Education in Katowice, Poland

<sup>2</sup>Medical University of Silesia Katowice, Dept. and Clinic of Orthopaedic and Traumatology, Poland

**Objective:** The aim of the study was therefore an attempt to assess changes in the parameters of the signal spectrum *quadriceps femoris muscle* bioelectrical, recorded during the so-called MVC test before and after a series of standardized tests assessing the functional status of the patient. **Methods:** A prospective study of 22 patients hospitalized in the Independent Public Clinical Hospital, Department of Orthopaedics and Traumatology Clinic Locomotor Medical University of Silesia in Katowice. The research project has been approved by the Bioethics Committee of the Medical University of Silesia (L.dz.KNW/0022/KB1/145/09). Patients with osteoarthritis of the knee were enrolled for a total knee surgery. The study was carried out before surgery. For measuring device used MyoTrace400 (Noraxon, USA) recording bioelectric signals of the three heads of *quadriceps femoris* muscle during MVC performed the test twice, before and after a series of functional tests.

**Result:** The results show the average frequency of changes in two of the three muscles evaluated VLO and VMO at the left side of the measurement signal during the test MVC EMG before and after the functional tests. **Discussion:** Conducted studies show the changes of frequency and amplitude of bioelectrical signal quadriceps MVC recorded during the test before and after a series of functional tests as compared to the prior tests, which may be indicative of muscle fatigue. Bioelectric signals from the test MVC is used to normalize the amplitude of electromyographic recording, so the difference could be as high as several percent, not because of increased muscle activity, but because of his fatigue and changes in amplitude and frequency characteristics. **Conclusions:** There are changes in the average frequency of the EMG signal measured during the test MVC before and after the functional tests. Changes are observed in two of the three muscles evaluated: **Vastus Lateralis Obliguss (VLO)** and **Vastus Medialis Obliguss (VMO)** on the left side.

The observed changes may affect the further analysis and interpretation of the standard bioelectrical signal changing its value by as much as ten percent. It is reasonable to control the degree of muscle fatigue especially during long or intensive research effort.



## **Building system of forecasting results jump height on neuro-fuzzy network cascade**

**Grigory Popov, I.U. Kriveckij, N.S. Bezrukov**

Russian state university of physical culture, sport, youth and tourism

Technically correct jump implies a certain execution sequence of movements, in which the athlete's center of mass takes off at the specified point and the athlete did not hit the bar. This collection is characterized by a number of biomechanical parameters. Goal is to create a model that predicts the biomechanical parameters in iterative mode set to guarantee a positive result for a specific athlete jump tall. Forecasting system consists of two modules: preprocessing block and block of neuro-fuzzy inference. Preprocessing block is implemented in the form of the exponential function for each input signal and serves to ensure equivalence between the converted data to the range and distribution. Neuro-fuzzy inference block is a converging tree structure of the four layers with nodes (on the first layer is the five sites, in a second - two, in a third-one, in a fourth-one) in each site focuses on hybrid network architecture of the ANFIS. Hybrid networks have only structure and different values of the coefficients, which are defined in the network. The neuro-fuzzy inference block is the output of each subsystem. For the first: sportsman lift center of mass in the strips and overcomes her if the coefficient is less than 0 or is not able to raise the center of mass of sufficient height. Error operation of the system for training and testing data was 0%. For the second: the athlete lifts the center of mass to the strips and overcomes her if the coefficient is less than 0 or is unable to raise the center of mass of the strips, but hits the bar. Error operation of the system for training data was 3.6%, and for testing is 18.2%. The athlete and coach have a tool to analyze and see what options and how to improve, to get a positive result.



## **Electromyographic activity pattern during gradual deactivation of the quadriceps femoris muscle**

**Kisiel-Sajewicz K., Mencil J., Siemionow V., Zhang L.D., Jaskólska A., Jaskólski A., Yue G.H.**

Academy of Physical Education in Wrocław, Poland

The aim of the study was to examine the deactivation pattern of the rectus femoris (RF), vastus lateralis (VL) and vastus medialis (VM) muscles from submaximal level of force. We hypothesized that activity pattern of three heads of human quadriceps muscle during gradual deactivation phases will be characteristic for each muscle.

Sixteen healthy volunteers (age:  $21.9 \pm 4.5$  years old; body mass:  $75.9 \pm 10.4$  kg; height:  $173.3 \pm 7.2$  cm; 11 men) with no history of neurological, muscular and skeletal disorders participated in this study. They performed isometric knee extension contractions using the dominant lower limb at a target level equal to 20% of maximal voluntary contraction force (MVC). In each trial, subjects held the force at the target for 10 s after reaching it, and then relaxed (deactivate) the force  $\sim 4\%$  MVC/s. Visual feedback of the exerted force together with the force target was provided. Muscle signals were quantified by analyzing root-mean-square (RMS) of the EMG signals of the VM, VL and RF during deactivation phases. The 0.256 s time windows were centered every 5% MVC during force descending phase to analyzed muscle activity pattern during deactivation phases at 20%, 15%, 10% and 5% MVC. The RMS values were normalized with respect to the computed RMS values of the MVC.

The normalized EMG RMS values were not different between the three tested muscles ( $P > 0.05$ ) during deactivation at 20, 15, 10, 5% of MVC. However, we found that the effect of deactivation phase on the normalized EMG RMS value was statistically significant ( $P < 0.05$ ) for three tested muscles. The RMS value decreased significantly every 5% force decrease from 20 to 5% MVC in the VL and RF muscles while the VM EMG amplitude did not show a significant difference between deactivation phases from 20% to 15% MVC and 15% to 10% MVC ( $P > 0.05$ ).

Concluding, (i) the lack of significant difference in RMS EMG between muscles at each level of MVC can be a consequence of the common drive to deactivate the motor units of synergistic group of muscles, while (ii) different EMG activity pattern during gradual deactivation may reflect variations in the individual muscle deactivation strategy in the quadriceps femoris that might be related to specific motor units' deactivation strategy within synergistic group to optimize efficiency under deactivation condition.



## **Modification of exercise by mehrsheed sinaki and nordic walking for secondary prevention in osteoporosis**

**Agnieszka Nawrat-Szołtysik, Józef Opara, Cezary Kucio**

Academy of Physical Education in Katowice, Poland

This report presents accessible and safe exercise program and Nordic Walking for the elderly persons suffering from osteoporosis. The aim of exercise and Nordic Walking is secondary prevention of osteoporosis. Classes are modeled on a program of exercises by Mersheed Sinaki, and other authors. In addition to increasing bone mass of the main benefits of physical exercise including Nordic Walking is described: to improve range of motion, agility, increase muscle mass and improve physical coordination. The greatest benefits of these exercises is to reduce the risk of falls.





## **Effectiveness of different types of verbal feedback during the learning of a complex motor task**

**Tomasz Niżnikowski, Jerzy Sadowski, Andrzej Mastalerz**

The Josef Pilsudski University of Physical Education in Warsaw, Faculty of Physical Education and Sport in Biala Podlaska, Poland

Many researchers (Salmoni, Schmidt, Walter, 1984, Wulf & Shea, 2004, Sadowski et. al., 2011) attempted to find the most appropriate methods of providing information through feedback to refine and develop motor skills. However, less is known about the effectiveness of verbal feedback in the learning of a complex motor task. The aim of this study was to investigate how different types of corrective verbal feedback improve learning of a complex motor task. **Material and Methods.** Thirteen students were randomly divided into two experimental groups. The first group (E) received verbal feedback about errors in the task performance (mean stature 178 cm  $\pm$  4.0 cm, body mass 79.4 kg  $\pm$  3.6 kg, age 20.4  $\pm$  1.2 yrs) and the second group (E&P) received verbal feedback about errors and correctness (mean stature 181 cm  $\pm$  3.9 cm, body mass 83.4 kg  $\pm$  3.8 kg, age 20.2  $\pm$  1.1 yrs). The progressive-part method was employed in this study. All participants completed three practice sessions per sixteen weeks. Prior to practicing, all of the participants received a demonstration of the task along with verbal guidance. In the course of the examinations the subjects learnt to perform a vertical jump with swinging arms forward and upward, pulling the knees to the chest and grabbing the shanks followed by half-squat landing with arms sideward. The subjects had not been familiar with this task before. **Results.** The ANOVA was used to estimate statistical significance of differences among measurements. The normality of distribution and homogeneity of variances were tested with the Shapiro-Wilk test. Probability level of  $p < 0.05$  was used as critical. For significant differences, Fisher post hoc test was used. The ANOVA with repeated measures analysis revealed a significant effect of Test Time ( $F(2,22) = 7.64$ ;  $p < .003$ ). There was no effect of Group ( $F(1,11) = 0.01$ ;  $p < 0.912$ ). Post hoc comparison indicated that significant improvement of performance was observed only in the group with verbal information about errors (E). The ratings observed in the posttest were significantly higher than in the pretest (10.3 %;  $p < .0003$ ) and further increase in ratings to 14.4 % during retention ( $p < .0001$ ) pointed to the improvement of task performance. All judges' ratings observed in the group with verbal information about errors and correctness (E&P) improved insignificantly. **Conclusion.** Providing too much verbal feedback during the learning of the vertical jump turned out to be less efficient than limited verbal feedback about the errors of performing the task.



## **Motor Learning is Enhanced in Older Adults following Training with a Less Difficult Task**

**Tanya Onushko, Changki Kim, Evangelos A. Christou**

University of Floryda, USA

Motor learning is impaired in older adults likely due to their inability to process information when practicing a novel motor task. There is some evidence that the age-associated differences in movement control are exacerbated during more difficult tasks. It is unclear whether these aging differences remain when the task difficulty increases with greater coordination demands or if there are any age-associated differences in motor learning when young and older adults train with an easy and a hard motor task. The purpose of this study was to determine whether the difficulty of the training task affects motor learning in young and older adults. Eighteen young (Y) ( $23.3 \pm 3.3$  years) and seventeen older (O) adults ( $72.9 \pm 8.2$  years) participated in this study. Subjects were instructed to track a moving target (dot) on a computer monitor by controlling isometric abduction forces of the index and little fingers. To determine whether training with a more or less difficult task would influence motor learning, subjects were assigned to one of three groups: Easy ( $0^\circ$  relative phase), Hard ( $90^\circ$  relative phase) and Control (no training). The level of difficulty was dependent on the relative timing (i.e. phase) of abduction force generation between the index and little fingers. Subjects practiced their assigned task for 80 trials one day prior to the testing session. During the testing session, Easy, Hard and Control groups performed three transfer tasks ( $45^\circ$ ,  $135^\circ$  and  $180^\circ$  relative phases) to test motor learning. We quantified force variability (sum of the variance of the force from each finger), overall error (sum of the root mean square error (RMSE) of each finger), and the timing error (sum of the timing delay between the target's trajectory and the force production for each finger). Older adults compared with young adults exhibited greater force variability, greater RMSE values and greater timing errors during the training trials ( $P < 0.05$ ). However, motor learning was enhanced for all subjects who trained with the easy task compared with the hard task and the control group. This was evident by lower RMSE and temporal errors and lower force variability during the transfer tasks ( $45^\circ$ ,  $135^\circ$  and  $180^\circ$  relative phases). The effect of training with the easy task on motor learning was greater for older adults. Overall, this finding suggests that practicing a simple task can enhance motor learning and reduce errors and variability in force control in older adults to a level near young adults.





## **Functional movement patterns and limitations vs. physical fitness preparation of 18 year old footballers**

**Marzena Paruzel - Dyja, Leszek Dyja, Janusz Iskra, Jarosław Wasilewski**

Academy of Physical Education in Katowice, Poland

Motor fitness test i.e. sprints or endurance tests are an important part of footballer's motor fitness preparation control. Functional Movement Screen is a grading system created by Cook G. to assess functional movement patterns, limitations and asymmetries or even the risk of injuries, most popular in the USA, recently used also in Poland. The aim of this study was to find correlations between the results in FMS system and other components of motor fitness preparation i.e. speed of running in the group of 18 year old footballers. The research group consisted of Polish footballers from teams playing in the highest youth league ( $n=48$ , age  $17,53 \pm 1,03$ , body mass  $69,43 \pm 6,99$  kg, body height  $177,95 \pm 6,10$  cm). The authors used several tests i.e. Functional Movement Screen, 30 m sprint run (time of 5 m, 10 m, 20 m and 30 m measured with the use of photo cells) PWC 170 test of physical capacity as well as a survey. Additionally body mass and height measurement was done with standard procedures and devices. Basic statistical methods (mean, SD, minimum and maximum values) were applied as well as the analysis of variance (ANOVA). The most significant correlations were found between the result of FMS system and PWC 170 test as well as time result in 5m sprint run.



**Influence of carrying out the execution criteria, during a shot on goal.  
Relationship between two groups of students from secondary school trained  
and untrained in soccer**

**César Peixoto, Cátia Valente, Miguel Moreira**

Technical University Lisbon - Human Kinetics Faculty, Portugal

The motor Tasks are a whole combination of different events for several specific situations. It is important that teachers can have a competent task analysis, error diagnosis and the ability to correct the movement, during the learning process.

Aim of study: 1» what is the influence of standard technique (individual), during the execution of a shot in football (success criteria/execution phases); 2» if there are differences between the practitioner and the non-practitioner groups, regarding the success; 3» and if the fact of being a practitioner of this activity, has any influence on the success (final goal – score).

Methods:

Sample: The study covered 30 boys from secondary school, divided into two groups of 15 boys. A control group has only Physical Education twice a week (age: 13 and 14), and the second group has Physical Education (twice a week) and they are integrated in school sports with three times a week for training (age: 11 and 12). 23 players use the right foot.

Statistical: Descriptive and T Test.

Procedures: To obtain data, they were asked to shot on goal with the ball stopped at a distance of 10 metres in 3 zones, defined in relationship with the center of the goal (front center; 45° - left side; 45° - right side). Each individual performs a shot from each zone.

Results: Statistical shows us only significant differences in execution phase » 0,037\*,  $p < 0.05$

Data analysis, point out that the best side of shot is for both groups the right side (23/30 complete with the right foot), being the area where you meet most part of the criteria for the success of this technique, during execution. Trunk rotation, in the initial phase of execution is the criterion less fulfilled by both groups, and the placement of the support leg for the shot is the most fulfilled criteria by two groups. The control group has less number of errors in the initial phase of the movement, while the trained group, is the group that complies with a greater number of execution criteria in the whole movement. More goals were scored when the shot is on the left side. The trained group achieved higher goals scores. The boys from the trained group with a lower goal score are the ones which meet fewer execution criteria.

Conclusion: The trained group does not show a relevant significant difference from the untrained group neither in the fulfillment of the execution criteria nor in the goals scores. Failing in meeting the execution criteria was related to a lower goal score.



## **Sport results in weightlifting and their determinations**

**Anna Pilis, Krzysztof Mizera, Cezary Michalski, Jakub Jelonek, Łukasz Grela,  
Karol Pilis**

Jan Długosz University in Częstochowa, Poland

Sports results achieved in weightlifting depend, among other factors, on somatic determinants which are changing throughout the training process. Therefore, the goal of the present study was to demonstrate the effect of somatic variables on sports results obtained in snatch, clean and jerk and both lifts during competitions. The measurements covered a group of 10 weightlifters from the National Polish Weightlifting Team. For this purpose, the authors measured mass and body height, fat and water content and then calculated lean body mass (LBM), body mass index (BMI) and mass/height ratio. The sports results achieved by each athlete were also recorded during national Polish championships represented by Sinclair coefficients, expressed in absolute values (kg), values relative to body mass (kg/kg) and values relative to LBM (kg/kgLBM). The authors calculated Pearson's linear correlation coefficient in order to evaluate the correlations between the sports results and somatic variables. The study demonstrated that somatic variables provide a very good measure for evaluation of absolute results obtained during snatch, clean and jerk and both lifts. It was found that among somatic variables used for description of training adaptations of weightlifters, the most useful is weight/height ratio. Analysis of the data contained in the study revealed that Sinclair score, which expresses absolute results achieved in weightlifting, did not correlate with somatic variables and relative results of snatch, clean and jerk and both lifts. These sports results expressed as relative to body mass have limited usefulness for evaluation of training adaptations of weightlifters and, if expressed as relative to LBM, are useless for this evaluation.



## **The use of selected linear models in predicting the results of 400-metre hurdles races**

**Krzysztof Przednowek, Janusz Iskra, Stanisław Cieszkowski**  
University of Rzeszow, Department of Physical Education, Poland

The main aim of the study is a verification of the efficiency of the use of linear models in prediction of the result in the 400-metre hurdle races. The study presents selected models of the linear regression performing the task of prediction the sports outcome on the basis of training loads. The models were constructed on the training loads of athletes doing 400 m hurdle races. The base training loads constituted training plans of highly trained contestants. The analysis takes into account three stages of annual cycle: the general preparation period, the special preparation period and the start up period. The classical model of multiple regression and shrinkage regression model was analysed.

**Key words:** sport prediction, hurdling, linear model, shrinkage method



## **The impact of sportive dancing compared to endurance/ strength training on cognitive skills in elderly.**

**Kathrin Rehfeld, Anita Hökelmann, Wolfgang Lehmann, Peter Blaser**

Department of Sport Science, University Magdeburg, Germany

Ageing goes along with physical and cognitive declines, which can be increased by physical inactivity and could lead to cardiovascular diseases or dementia. But not all ageing declines are genetically determined or irreversible. Especially physical activity provides a protective impact on physical and cognitive skills (Schaller & Wernz, 2010). An auspicious facility to be active and keep or increase elderly fitness (neurophysiologic-, physiologic-, psycho-social- and cognitive status) is dancing, because it combines motor, coordinative and cognitive ascendancies (Jacobson, 2005). In our 16month longitudinal study, we included 95 seniors at the age of 60 to 75 years ( $M=68,58$ ;  $SD= 4,16$ ) and randomized them into three intervention-groups: Dance, Dance and Sport, Sport. The dancing group practiced different choreographies of several genres (Samba, Rock 'n' Roll, Jazzdance, Line Dance) once a week for 90 minutes. The group Dance and Sport received the identical dance-intervention. In addition they practice strength and endurance training for once a week. The last group Sport did endurance and strength training once a week. We used the ZVT (Number-Connecting-Test; Oswald & Roth, 1987) to measure the fluid intelligence and the information processing speed. The LPS 50+ (Performance Testing System for 50 till 90 years old by Sturm, Willmes & Horn, 1993) analyzed the general intelligence (spatial orientation, word fluency, perception differentiating, spelling skills) and the last test BIS (Berlin Intelligence Structure Test by Jäger, Süß & Beauducel, 1997) measured the retentivity performance of the working memory (pre-test, post-test 1 after 8 month, post-test 2 after 16 month). The results show a significant increase from pre- to post-test 1 in all cognitive variables in all three groups. But the performance of the sport group stagnate from post-test 1 to post-test 2, while the performance of the other two groups rise continuously. Those results are statistically shown in interaction-effects (group x time): General intelligence ( $\eta^2 = .141$ ); fluid intelligence ( $\eta^2 = .145$ ) and working memory ( $\eta^2 = .065$ ). With a continuous dance training, it is possible to increase the cognitive performance of seniors steadily. In our further study we will confirm our findings (behavioral data) with neurophysiologic parameters. We will investigate the influence of (sportive) dancing and general health sport to the neurogenesis of neurons in elderly using magnetic resonance imaging and blood analysis. Ethics proposal is approved.



## **Balance Asymmetry Quotient - The importance of separate measurements of lower limbs in posturography**

**Mariusz Strzecha**<sup>1,3</sup>, **Henryk Knapik**<sup>2,3</sup>, **Paweł Baranowski**<sup>4</sup>,  
**Jan Pasiak**<sup>5</sup>, **Agata Pękala**<sup>6</sup>, **Karol Senderowicz**<sup>6</sup>

<sup>1</sup> Wydział Nauk o Zdrowiu, Wyższa Szkoła Nauk Społecznych i Technicznych w Radomiu, Polska

<sup>2</sup> Katedra Metod Specjalnych Fizjoterapii i Sportu Osób Niepełnosprawnych, Wydział Fizjoterapii, Akademia Wychowania Fizycznego, Katowice, Polska

<sup>3</sup> Wydział Nauk o Zdrowiu, Radomska Szkoła Wyższa, Polska

<sup>4</sup> Centrum Rehabilitacji im. prof. M. Weissa "STOCER", Konstancin – Jeziorna, Polska

<sup>5</sup> Katedra Badań Operacyjnych i Ekonometrii, Politechnika Radomska, Polska

<sup>6</sup> Laboratorium Diagnostyki Zdrowia „KOORDYNACJA”, Radom, Polska

**Purpose:** This article indicates the necessity of concurrent measurement of separate actions of lower limbs during examination of balance. In the article were presented Balance Asymmetry Quotient. This researches were supported by National Centre of Science in Poland and were performed in Health Diagnostic Laboratory in Radom.

**Basic procedures:** Research material comprised the group of 444 persons including 193 women and 251 men. All participants had to stand on two-platform stabilographic scale barefoot in individual relaxed standing position. One foot rested on one plate of the posturograph while the other on second plate. **Main findings:** Analysis of the data reveals that the examined who obtained similar results in single-platform posturograph are characterized by entirely different method to maintain stable standing position. Only two of the examined persons achieved equal value for lower left and right limbs, which might prove symmetrical stability of lower limbs. Highest asymmetry was observed for the many person, at the level of over 1000%.

**Conclusions:** Separate concurrent measurements carried out for each limb allowed to show considerable differences (in balance parameters) between persons who obtained similar results in single-platform posturographs. The presented results point to the need for stabilographic investigations of transfer center of pressure (COP) using concurrent and independent measurement of transfer of COP<sub>LL</sub> (leg left) and COP<sub>LR</sub> (leg right) and the registration of changes in balance. The present paper presents new cognitive opportunities connected with implementation of new measurement/analysis techniques into stabilography in the form of two-platform stabilographic scales. Such a development in measurement opportunities for stabilography offered by two-platform posturograph might contribute to verification of a number of views existing in this domain.

**Key words:** postural sway, postural control, body balance, posturography, balance asymmetry quotient.



## **The influence of the additional task on postural stability**

**Krzysztof Szydło, Kajetan Słomka, Rafał Zając, Patrycja Kołacz, Grzegorz Juras**  
Academy of Physical Education in Katowice, Poland

The aim of this study was to determine the effects of additional task on postural stability and to determine the attentional demands for maintaining stable body posture. Intention of this research was also to answer the question: What is involved in the conscious control of the body to maintain balance?

Fifteen healthy young male volunteers participated in this study. The equipment used in this research were: force platform (AMTI, model AccuGait, USA), with a PC computer with Balance Trainer software, head mounted display (Z800 3Dvisor eMagin, USA), and reaction time measurement device (MCZR/ ATB 1.0). Participants performed 6 trials. Each lasted 60 seconds. During the first trial subjects stood on the platform performing only the stability task, in second trial subjects stood on the platform performing the stability task and at the same time they had to respond to acoustic stimulus by pressing the button (simple reaction condition). In simple reaction time conditions participant responded to 12 stimuli, in choice reaction time condition to 18 stimuli. In order to create more challenging conditions in some trials soft base of support was introduced (10 cm thick foam). In third trial subjects performed the same task on the force plate but had to respond to two types of acoustic signals- high and low (choice reaction condition). In next three trials subject performed the same tasks but on soft base of support. Average Target Hit Time and Average Area Deviation were the main variables registered and further analyzed. Also reaction times (simple and choice reaction) were measured but not included in this analysis. Results suggests that increasing task difficulty may lead to less precise execution of postural task but does not affect the time required for task execution.





## **Changes in the level of stability while standing on the balance platform on a rigid and compliant surface**

**Dariusz Tchórzewski, Janusz Jaworski**

University School of Physical Education in Cracow, Poland

The contribution of individual of individual sensory inputs in postural control is not equal. It is believed that a particularly important role in the development of postural response proprioceptive inputs play. Fluctuations of the balance platform (seesaw) cause continuous changes in orientation, which is a major difficulty in the use of proprioceptive information about the relative body positions. While standing on an unstable surface comes to the reorganization of postural control mechanisms and their adaptation to new environmental conditions, resulting in increased body's sways and a change in postural strategy. This ability to compensate of the loss or retention of information from one or even two sources of sensory input by reorganizing and re-establish the importance of information from all the senses is important to maintain stability. The main aim of this study was to determine to what extent, with the help of visual feedback mechanisms of postural control can compensate the distortion of proprioceptive information caused by two factors. First factor disturbance with balancing on a rigid support surface of the platform, while the second additional place on a platform of compliant surface. An attempt to answer the questions: (1) as additional disturbance due to soft ground affects the level of postural stability? and (2) if this effect is similar in the planes of motion? The studies included 20 young healthy men (age  $20.63 \pm 0.58$ ). For measuring the stability, EasyTech's Libra - the balance platform (seesaw) has been used. Compliant surface obtained by place to the platform air filled ball cushion Aerostep by TOGU. The task of the subject's was to keep the platform in the horizontal. The study was conducted separately in the frontal and sagittal planes. In the frontal plane, the results showed no differences in the stability of the examined balance between the two conditions, whereas in the sagittal additional soft surface caused the deterioration of their stability. The balancing act on a rigid surface, no difference of results obtained in both planes. On soft subjects achieved greater stability in the frontal plane.





## **Fitness assessment in ice hockey**

**Milan Turek, Marek Kokinda, Robert Kandrac**

University of Presov, Slovakia

Taking into consideration the increasing demands of the game, the assessment of motor fitness in ice hockey players requires perfection of the diagnostic tools that include parameters of actual and continuous states. At the same time, it is crucial that the material and technical conditions for the research be secured. The research was based on the methods of the specialized Hockey Development Centre, which houses equipment using which it is possible to model motor workload with relatively high degree of precision in laboratory conditions. This type of model enables to summarize a great deal of information on individual states and changes in specific motor fitness and functional changes in individual age categories.



## **Hockey fitness relative to age categories**

**Milan Turek, Marek Kokinda, Robert Kandrac**

University of Presov, Slovakia

The research objective was to analyze the general and specific motor fitness in ice hockey players relative to age categories. During the season, students of ice hockey classes experience change in the level of their general and specific motor fitness, which is primarily determined both by the training process in the hockey club and by the individual approach in the specialized Hockey Development Centre in Košice. The acquired knowledge and evidence are used when designing training programs and testing as a part of the training process of ice hockey players of individual age categories.



## **Specificity of learning in stabilometer balance tasks with and without vision**

**Martin Wünnemann**

Universität Paderborn, Germany

Based on experiments using pointing tasks Proteau (1992) claims that motor learning is specific for the sensory information available during practice. Robertson & Elliott (1996) tested this hypothesis with the task of quickly crossing a balance beam. They showed specific improvements for the task without vision. However, they could not confirm specific learning for the task with vision available due to floor effects. This transfer experiment tests the specificity hypothesis concerning availability of vision with stabilometer tasks. 36 healthy subjects ( $26.1 \pm 5.2$  y.) had to level the platform of a stabilometer with two axes (anterior-posterior [ap], medial-lateral [ml]) as horizontal as possible for 30 s with vision (task vision) or wearing opaque glasses (task no vision) in a pre- and a post-test. Dependent variables are deviations from the horizontal in each axis (RMSEs). In between the tests, two groups ( $n = 12$ ) practiced balancing on the stabilometer with (group “vision”) or without vision (group “no vision”) for 4 weeks twice a week ( $10 \times 1$  min). A control group ( $n = 12$ ) did not practice. The alpha level for significance was set at  $p_{adj} < .05$ . Hypotheses predicting no difference are tested for  $p > .20$ . Both groups reduced RMSEs in the practiced condition more than the control group,  $F_s(1,22) \geq 5.26$ ,  $p_{adj} \leq .018$ ,  $\eta^2 p_s \geq .19$ , with one exception, group “no vision” (ap-axis),  $F(1,22) = 0.67$ ,  $p_{adj} = .242$ ,  $\eta^2 p = .03$ . The absence of transfer among the tasks with changed visual conditions is confirmed,  $F_s(1,22) \leq 1.22$ ,  $p_s \geq .282$ ,  $\eta^2 p_s \leq .05$ , with one exception, group “no vision”, task vision (ml),  $F(1,22) = 2.96$ ,  $p = .100$ ,  $\eta^2 p = .12$ . All in all results are in accordance with the specificity hypothesis, albeit we did not verify the expected absence of transfer from task no vision to task vision regarding RMSEs in the ml-axis. Along with the absent task-specific improvements in group “no vision” (ap-axis) the results indicate that visual information may be more relevant for postural control in the ap-axis than in ml-axis of this stabilometer. O’Connor & Kuo (2009) showed that in parallel stance centre of pressure variability is more affected by visual perturbations in ap-direction than by visual perturbations in ml-direction, whereas in tandem stance the opposite is true. Their explanation of differences in the base of support being responsible for different weighing of visual information may be true for our results, too.



## **Reliability of jumping test as a tool for evaluation of rhythm of movement**

**Rafał Zajac, Krzysztof Szydło, Patrycja Kołacz, Kajetan Słomka, Grzegorz Juras**  
Academy of Physical Education in Katowice, Poland

Rhythmic motor activity and ability to synchronize with the given tempo, has been widely explored. Most of the studies concern finger tapping in various experimental groups, like children with developmental coordination disorder (DCD), or with attention deficit hyperactivity disorder (ADHD). Other studies aim to explore the development of rhythmic adjustment to the external stimuli and mechanisms underlying these processes. There is a need to include more simple and reliable tests in the research that could be valuable tools in evaluating rhythmic abilities for school teachers and coaches. The main goal of this study was to evaluate reliability of a simple sense of rhythm test with the use of intra class correlation model (ICC).

The rhythmic performance was measured with Optojump Next (Microgate, Italy). Eleven young healthy volunteers took part in the experiment. Subjects were asked to stand in the area between two optojump bars and perform six trials. All trials consisted of two phases (guided and self paced) - 20 jumps each. During the first one (guided) subject performed 20 jumps with the goal to synchronize within the rhythm provided with metronome (frequency of the signals was set to 1 Hz). After that metronome was turned off (self paced phase) and subject's task was to maintain jumping pace during the next 20 jumps. We analyzed jumping pace expressed in jumps per second and calculated for both phases in each trial. The reliability of the conducted measurements was estimated with the use of ANOVA based intraclass correlation coefficients (ICCs).

Depending on the test phase different numbers of trials should be performed. In order to achieve reliability index  $R=0.7$  in the guided phase 11 trials should be registered should be performed which is relatively large number. The self paced phase requires only 5 repetitions to reach the same reliability target. Perhaps subjects focus on the external auditory signal which reduced attention invested in the main task and resulted in less reliable results. On the other hand a significant number of jumps in each trial may have been the cause of the worse results during the first phase.



## **Impact of exercise intensity on inner plexiform layer of the retina**

**Teresa Zwierko, Lubiński W., Krzepota J., Lesiakowski P., Czepita D.**

University of Szczecin, Poland

The intricate circuitry formed by bipolar, amacrine and ganglion cells in the inner plexiform layer of the retina plays a major role in shaping the visual information. The purpose of this study was to determine whether the inner plexiform layer of the retina is altered after exercise by examining the oscillatory potentials of the flash electroretinogram (fERG) in healthy individuals (n=12). Participants performed three 10-min tests of increasing intensity on a cycle ergometer. Each participant was assigned individual workloads below the lactate threshold (40% VO<sub>2</sub>max), at the lactate threshold ( $\approx$  60% VO<sub>2</sub>max), and above the lactate threshold (80% VO<sub>2</sub>max). Five recordings of the fERG amplitude and implicit time were measured: pre-exercise, immediately after each of the three subsequent tests and in control condition. With increasing intensity of exercise the gradual reduction in amplitude of fERG parameters was observed. This findings suggest that strenuous physical effort may disturb a signal processing in the inner retinal layer.