

World Confederation for Physical Therapy  
**CONGRESS 2017**  
Cape Town

# Accepted Abstracts BFH & Partner



Berner Fachhochschule  
Haute école spécialisée bernoise  
Bern University of Applied Sciences



## Information from WCPT committee

From over 1600 abstracts submitted, abstracts have been selected for presentation at WCPT Congress 2017 as:

- poster presentations or
- platform presentations (rapid five, state of the art, classic)

Members of the Bern University of Applied Sciences and their partners submitted 25 abstracts for the WCPT 2017 in Cape Town and all twenty-five of them were accepted!

### Accepted as “Platform Presentation”

**Eggmann Sabrina et al.:** Functional effects of early, combined endurance and resistance training in mechanically ventilated, critically ill patients: a randomized controlled trial

**Koenig Irene et al.:** Wavelet analysis of muscle activity of lower extremities and pelvic floor muscles in women while walking or running: A systematic review

**Luder Gere et al.:** Effect of resistance training in women with joint hypermobility - results of a pragmatic randomized controlled trial

**Rogan Slavko et al.:** Effects of hip abductor muscles exercises on pain and function in people with patellofemoral pain: a systematic review and meta-analysis

**Schitter Agnes et al.:** Systematic review on applications, indications, and effects of passive hydrotherapy WATSU (WaterShiatsu)

**Schmidt Leuenberger Joachim et al.:** Effects of early clinical assessments of dysphagia on the incidence of aspiration pneumonia in patients undergoing elective pulmonary-resection surgery

**Schuster-Amft Corina et al.:** Effect of a virtual reality-based training on upper limb function in patients after stroke: a single-blinded randomised controlled multi-centre trial

**Verra Martin et al.:** Long-term outcome of knee osteoarthritis after comprehensive rehabilitation – 5 year follow up and risk for total knee arthroplasty

### Accepted as “Poster Presentation”

**Baur Heiner et al.:** Comparison of foot orthoses construction strategies to unload the forefoot in running

**Blasimann Angela et al.:** Navicular Rise: a possibility to describe dynamic foot function during stance? A descriptive cross-sectional laboratory study.

**Eichelberger Patric et al.:** Coupling of navicular mobility and foot length change during walking

**Friedemann Berit et al.:** German translation and validation of the Postural Assessment Scale for Stroke Patients (PASS) in people with acute stroke

**Herren Kaspar et al.:** Exercise and other non-pharmaceutical interventions for cancer-related fatigue in patients during or after cancer treatment: a systematic review incorporating an indirect-comparisons meta-analysis

**Hilfiker Roger et al.:** Exercise and other non-pharmaceutical interventions for cancer-related fatigue in patients during or after cancer treatment: a systematic review incorporating an indirect-comparisons meta-analysis

**Koenig Irene et al.:** Crosstalk considerations in studies evaluating pelvic floor muscles using surface electromyography in women: a scoping review

**Kuhn Manuel et al.:** Development of the international classification of functioning, disability and health incontinence assessment form (ICF-IAF)

**Luder Gere et al.:** Resistance training in women: influencing factors and differences versus men - systematic review of the literature

**Luginbuehl Helena et al.:** Involuntary reflexive versus standard voluntary pelvic floor muscle training: RCT protocol testing a new therapy concept for stress urinary incontinence

**Mueller Mebes Christine et al.:** Symptoms in daily life and activity level of women with and without hypermobility

**Pohl Johannes et al.:** The influence of gait and speed on the dynamic navicular drop - a cross-sectional study on healthy subjects

**Rogan Slavko et al.:** Impact of ankle joint mobilization on time-to-stabilization and on the peroneus longus muscle activity - a single case study

**Schmid Stefan et al.:** Age-related differences in spinal motion during gait

**Schmid Stefan et al.:** Is upper limb motion influenced by a structural leg length discrepancy in adolescents during gait?

16 poster presentations

8 platform presentations

**Σ = 25 akzeptierte Beiträge**

One accepted abstract had to be withdrawn (Stefan Schmid) as only two contributions per presenting author are allowed.

## Content (all accepted abstracts)

Baur Heiner et al.: Comparison of foot orthoses construction strategies to unload the forefoot in running	5
Blasimann Angela et al.: Navicular Rise: a possibility to describe dynamic foot function during stance? A descriptive cross-sectional laboratory study.	6
Eggmann Sabrina et al.: Functional effects of early, combined endurance and resistance training in mechanically ventilated, critically ill patients: a randomized controlled trial	7
Eichelberger Patric et al.: Coupling of navicular mobility and foot length change during walking	8
Friedemann Berit et al.: German translation and validation of the Postural Assessment Scale for Stroke Patients (PASS) in people with acute stroke	9
Herren Kaspar et al.: Exercise and other non-pharmaceutical interventions for cancer-related fatigue in patients during or after cancer treatment: a systematic review incorporating an indirect-comparisons meta-analysis	10
Hilfiker Roger et al.: Exercise and other non-pharmaceutical interventions for cancer-related fatigue in patients during or after cancer treatment: a systematic review incorporating an indirect-comparisons meta-analysis	11
Koenig Irene et al.: Crosstalk considerations in studies evaluating pelvic floor muscles using surface electromyography in women: a scoping review	12
Koenig Irene et al.: Wavelet analysis of muscle activity of lower extremities and pelvic floor muscles in women while walking or running: A systematic review	13
Kuhn Manuel et al.: Development of the international classification of functioning, disability and health incontinence assessment form (ICF-IAF)	14
Luder Gere et al.: Effect of resistance training in women with joint hypermobility - results of a pragmatic randomized controlled trial	15
Luder Gere et al.: Resistance training in women: influencing factors and differences versus men - systematic review of the literature	16
Luginbuehl Helena et al.: Involuntary reflexive versus standard voluntary pelvic floor muscle training: RCT protocol testing a new therapy concept for stress urinary incontinence	17
Mueller Mebes Christine et al.: Symptoms in daily life and activity level of women with and without hypermobility	18
Pohl Johannes et al.: The influence of gait and speed on the dynamic navicular drop - a cross-sectional study on healthy subjects	19
Rogan Slavko et al.: Effects of hip abductor muscles exercises on pain and function in people with patellofemoral pain: a systematic review and meta-analysis	20
Rogan Slavko et al.: Impact of ankle joint mobilization on time-to-stabilization and on the peroneus longus muscle activity - a single case study	21
Schitter Agnes et al.: Systematic review on applications, indications, and effects of passive hydrotherapy WATSU (WaterShiatsu)	22
Schmid Stefan et al.: Age-related differences in spinal motion during gait	23
Schmid Stefan et al.: Is upper limb motion influenced by a structural leg length discrepancy in adolescents during gait?	24
Schmid Stefan et al. Does an orthotic correction of lower extremity function during gait influence spinal motion in hemiplegic cerebral palsy patients? Accepted but withdrawn because of limited number of contribution per presenting author	25
Schmidt Leuenberger Joachim et al.: Effects of early clinical assessments of dysphagia on the incidence of aspiration pneumonia in patients undergoing elective pulmonary-resection surgery	26
Schuster-Amft Corina et al.: Effect of a virtual reality-based training on upper limb function in patients after stroke: a single-blinded randomised controlled multi-centre trial	27
Verra Martin et al.: Long-term outcome of knee osteoarthritis after comprehensive rehabilitation - 5 year follow up and risk for total knee arthroplasty	28

## Comparison of foot orthoses construction strategies to unload the forefoot in running

Baur Heiner<sup>1</sup>, Hähni Michaela<sup>1</sup>, Hirschmüller Anja<sup>2</sup>

<sup>1</sup>Bern University of Applied Sciences, Health, Berne, Switzerland

<sup>2</sup>University Hospital Freiburg, Clinic for Orthopaedic and Trauma Surgery, Freiburg, Germany

<sup>3</sup>Altius Swiss Sportmed Center, Rheinfelden, Switzerland

**Background:** Foot orthoses are often prescribed in activity-related overuse injuries despite clear evidence. A primary goal of therapy is pain reduction and symptomatic relief. Depending on the pathology and construction principle, foot orthoses are thought to achieve unloading of specific foot areas. For the forefoot area one strategy is to redistribute pressure from the forefoot to the midfoot by metatarsal pads. Another strategy is to apply local cushioning material under the symptomatic areas in the forefoot. It is still unclear which strategy works best in dynamic situations like running.

**Purpose:** The purpose was therefore to analyse the effects of two different foot orthoses construction strategies (forefoot cushioning FC; metatarsal pad MP) on plantar pressure in the forefoot area.

**Methods:** This experimental laboratory study included 23 asymptomatic amateur runners (female: 13, male 10; age:  $31.7 \pm 9.4$  yrs.; height:  $1.72 \pm 0.09$  m; weight:  $64.0 \pm 8.6$  kg; running volume:  $166 \pm 101$  min per week). The runners had to accomplish running intervals (treadmill:  $2.78 \text{ m}\cdot\text{s}^{-1}$ ; duration: 2 min) with randomly assigned either one of the two test conditions (FC, MP) or a control foot orthosis (CO) without functional elements implemented. Plantar pressure was measured with an in-shoe device (Pedar-x®-System, Novel®, Munich, D). The means of 10 steps of the maximum peak pressure [kPa] in the forefoot (primary outcome) and the total foot [kPa] were extracted. Furthermore comfort ratings by means of the ICI (insole comfort index, sum score 0-100) were taken as secondary outcome after each running interval. Group differences of the primary outcome peak pressure in the forefoot area were tested by the Friedman-Test ( $\alpha=0.05$ ). The remaining outcomes were descriptively evaluated (mean  $\pm$  standard deviation; median; lower & upper 95%-confidence interval; CI).

**Results:** The peak pressure [kPa] under the forefoot area was in FC ( $281 \pm 80$ , 95%-CI 246-315) significantly ( $p=0.003$ ) reduced (11%) compared to CO ( $313 \pm 69$ , 95%-CI: 283-343). This was also shown in the comparison of FC to MP (MP:  $315 \pm 80$ , 95%-CI: 280-350;  $p=0.001$ ). This means a reduction by 12%. No difference was found between CO and MP ( $p=0.858$ ). Peak pressure [kPa] under the total foot were CO  $364 \pm 82$ , 95%-CI: 328- 399; MP  $357 \pm 80$ , 95%-CI: 326- 387; FC  $333 \pm 81$  95%-CI: 298-368. The ICI-score (median) was 50 for CO, 47 for MP and 54 for FC.

**Conclusions:** Local forefoot cushioning is the method of choice to reduce pressure under the respective foot area. In contrast to metatarsal pads, forefoot cushioning can result in significant reductions of plantar pressure. In dynamic situations like running, metatarsal pads should therefore not be implemented in foot orthoses. All tested conditions were rated similar in comfort. Differences in comfort did therefore not influence running execution of subjects. If patients (e.g. metatarsalgia patients) can benefit from forefoot cushioning short- and/or long-term should be evaluated in prospective randomized and controlled intervention studies.

**Implications:** If mechanical unloading of the forefoot is a goal in the treatment of forefoot pathologies, cushioning of symptomatic areas helps to reduce plantar pressure. Therefore orthopaedic devices can accompany physiotherapy treatment modalities especially during physical activity.

**Key words:** forefoot cushioning, metatarsal pad, plantar pressure

**Funding acknowledgement:** Foot orthoses were provided by IETEC Orthopädische Einlagen GmbH, Künzell, Germany. No further external funding was received for this project.

**Ethics approval:** The study was evaluated by the Ethics Committee of the Canton Bern (KEK-Nr. Z039/12) and was classified as "low risk".

## Navicular Rise: a possibility to describe dynamic foot function during stance? A descriptive, cross-sectional laboratory study

Blasimann Angela<sup>1</sup>, Eichelberger Patric<sup>1</sup>, Lutz Nicole<sup>1</sup>, Radlinger Lorenz<sup>1</sup>, Baur Heiner<sup>1</sup>

<sup>1</sup>Bern University of Applied Sciences, Health, Berne, Switzerland

**Background:** Adult acquired flatfoot is a frequent problem with 19% prevalence and leads to hazardous complaints and walking dysfunction. It is generally believed that the dynamic foot function depends to a significant extent on the shape of the foot. While static alignment features (e.g. static navicular drop) are commonly assessed, their validity to describe dynamic foot function has not been established. To gain a most possible comprehensive view on physiological changes during functional activities (e.g. level walking, stair climbing), dynamic “mechanics” have to be measured with three-dimensional motion capture systems.

**Purpose:** The aims of this descriptive, cross-sectional laboratory study were to investigate the reliability of a new parameter, the dynamic navicular rise (dNR), and its relationship with the dynamic navicular drop (dND) during level walking and stair descent.

**Methods:** To assess the navicular bone motion during stance, 20 healthy participants (mean age  $30.2 \pm 8.1$  years) had to walk on even ground and downstairs. A three-dimensional motion capturing system and force plates recorded data of ten trials per task on two measurement days. The dNR was extracted from the mean curves and defined as the difference between the minimum navicular height during stance and the navicular height at toe off. To test intra- and interday reliability, Bland-Altman plots were drawn, Intraclass Correlation Coefficients ( $ICC_{2,1}$ ) and repeatability were calculated. Furthermore, the relationship between the dNR and the dND was examined by calculating Pearson ( $r$ ), Spearman ( $r_s$ ) correlations and regression coefficients ( $b$ ), and visualization with scatterplots.

**Results:** Included participants showed a mean dNR of ( $12.2 \pm 3.7$ ) mm for level walking and ( $14.8 \pm 3.4$ ) mm for stair descent. The  $ICC_{2,1}$  for the dNR were 0.98 (intraday), 0.91 (interday) for level walking and 0.97 (intraday), 0.94 (interday) for stair descent. The repeatability for interday comparisons was 3.2 mm for level walking and 2.7 mm for stair descent. The correlation coefficients for comparison of the dNR with the dND were  $r = 0.31$ ,  $b = 0.5$  ( $p = 0.049$ ) for level walking, and  $r_s = 0.88$ ,  $b = 1.08$  ( $p < 0.001$ ) for stair descent.

**Conclusion(s):** Regarding ICCs, the dNR seems to be highly reliable. However, the repeatability is not acceptable. For level walking, the dNR may tend to be an independent measure for late stance dynamics. For stair descent, the dNR resembles the dND and therefore, gives no additional information. As only healthy subjects had been measured, the results cannot be transferred directly to patients. Future research should include larger sample sizes and/or focus on patients.

**Implications:** To better understand foot function under dynamic conditions, more research in the movement laboratory but also the transfer in a less sophisticated surrounding is needed to bring the results into daily practice.

Even though not every person with flatfoot gets symptoms, it is worth to know the underlying mechanisms as well as biomechanical consequences for posture and motion in order to support prevention for the known associations between flatfoot and foot pain, low back pain and for example medial tibial stress syndrome.

**Key words:** gait analysis, foot function analysis, navicular bone

**Funding acknowledgements:** This work was funded by the Swiss National Science Foundation (Project number 140928).

**Ethics approval:** Ethics approval was obtained from the ethics committee of the Canton Berne, Switzerland (KEK N° Z007/12).

## Functional effects of early, combined endurance and resistance training in mechanically ventilated, critically ill patients: a randomized controlled trial

Eggmann Sabrina<sup>1</sup>, Verra Martin L.<sup>1</sup>, Luder Gere<sup>1</sup>, Takala Jukka<sup>2</sup>, Jakob Stephan M.<sup>2</sup>

<sup>1</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland,*

<sup>2</sup>*Inselspital, Bern University Hospital and University of Bern, Department of Intensive Care Medicine, Bern, Switzerland*

**Background:** Recovery from critical illness is frequently complicated due to neuromuscular dysfunction resulting in severe functional impairment and reduced quality of life. Early physiotherapy may improve functional outcomes, but the optimal rehabilitation interventions are not known.

**Purpose:** This prospective, single-centre, allocation-concealed and assessor-blinded randomised controlled trial aimed to compare the functional effects of early mobilisation in combination with endurance and resistance training to usual physiotherapy care practice in mechanically ventilated adults of a mixed intensive care unit (ICU).

**Methods:** Eligible patients were  $\geq 18$  years, had an expected mechanical ventilation for  $>72$  hours and were independent before the onset of critical illness. Participants were randomised to either an experimental group receiving early mobilisation with endurance (cycling in bed) and resistance training or to a control group with standard physiotherapy including early mobilisation with active or passive exercise. The primary outcomes were functional capacity (6-Minute Walk Test) and recovery of functional abilities (Functional Independence Measure) measured at hospital discharge. Secondary outcomes included muscle strength (Medical Research Council sumscore, handgrip strength, handheld dynamometry), exercise capacity (Timed 'Up&Go' Test), length of stay (ICU, hospital) and days on mechanical ventilation. Safety was closely monitored and adverse events were noted. Statistical analysis was per protocol, using students-t-test or Mann-Whitney-U-test to detect differences between groups. The level of significance was set at  $p < 0.05$ .

**Results:** Participants ( $n=115$ , age  $64 \pm 15$ , BMI  $27 \pm 5$ , APACHE2  $22$ (IQR9.5)) were allocated to start either the experimental ( $n=58$ ) or control ( $n=57$ ) intervention within 1.8 days of ICU admission. Altogether, the experimental group had 409 sessions on 73% of study days (mean ICU days  $9 \pm 9$ ), respectively 380 on 65% ( $12 \pm 17$ ) for the control group. There were no significant differences between groups in the 6-Minute Walk Test ( $p=0.443$ ,  $n=107$ , experimental: 123m (IQR261), control: 90m(IQR300)) and Functional Independence Measure ( $p=0.207$ ,  $n=106$ , experimental: 98(IQR56), control: 97(IQR95)) at hospital discharge. At ICU discharge, the incidence of ICU-acquired weakness (ICU-AW) was high (59%), but not different between groups ( $p=0.461$ ,  $n=83$ ). Likewise, there were no significant differences for the secondary outcomes. Six-month mortality was 28.7% with no significant differences ( $p=0.883$ ,  $n=115$ ). Overall, there were 4 (0.5%) minor adverse events without further consequences.

**Conclusion(s):** Early physical training starting within 1.8 days of ICU admission proved to be safe. However, there were no significant differences in functional recovery in this randomised controlled trial comparing early mobilisation with endurance and resistance training to usual physiotherapy practice in a mixed, adult ICU. When interpreting these results one needs to take into account that both groups started rehabilitation very early after ICU admission, had a similarly high frequency of physiotherapy and discontinued the study protocol after ICU discharge. All this might have led to small dose differences between groups.

**Implications:** This trial adds to the evidence that very early mobilisation and rehabilitation in the ICU is safe. Moreover, if started early, it might improve functional outcomes. However, the most effective interventions still need to be determined. Considering the high heterogeneity, future trials should identify and specifically target patients at risk for neuromuscular complications (ICU-AW) and aim to continue the protocol on the wards.

**Key words:** Functional impairment; mechanical ventilation; early rehabilitation

**Funding acknowledgements:** This study was supported by the Departments of Physiotherapy and Intensive Care Medicine, Inselspital, Bern University Hospital, Bern, Switzerland

**Ethics approval:** The study was approved by the local ethics committee of Bern, Switzerland (Reference Number: 122/12)

## Coupling of navicular mobility and foot length change during walking

Eichelberger Patric<sup>1</sup>, Blasimann Angela<sup>1</sup>, Woodtly Sira I.<sup>1</sup>, McEvoy Julien C.<sup>1</sup>, Bohnenblust Marion<sup>1</sup>, Kaufmann Evelyne<sup>1</sup>, Krause Fabian<sup>4</sup>, Baur Heiner<sup>1</sup>

<sup>1</sup>Bern University of Applied Sciences, Health, Physiotherapy, Bern, Switzerland

<sup>2</sup>Graduate School for Cellular and Biomedical Sciences, University of Bern, Bern, Switzerland <sup>3</sup>University Hospital Bern, Inselspital, Department of Orthopaedic Surgery

**Background:** Although multi-segment foot models offer dedicated approaches to detect intrinsic foot kinematics, they lack of clinical applicability due to complexity, preparation time and cost-intensive instrumentation. We therefore propose to measure intuitive parameters to assess dynamic foot function: navicular drop (NDrop, difference between the minimum navicular height (NH) during stance and NH at heel strike), navicular rise (NRise, difference between NH at toe off and minimum NH during stance), navicular drift (NDrift, maximum medial navicular deviation during stance), as well as foot lengthening (FLen) and shortening (FShort).

**Purpose:** The study aimed to explore reliability and movement coupling of vertical navicular motion, with the medial navicular drift and foot length change during stance.

**Methods:** A set of four reflective spherical markers (1st and 5th metatarsal heads, heel, navicular tuberosity) was applied bilaterally on twenty healthy subjects. Ten trials were averaged to calculate representative stance phase time series from which NDrop, NRise, NDrift, FLen and FShort were extracted. The test session was repeated on the same day and one week apart to assess intra- and interday reliability, respectively. The reliability was evaluated with the Bland-Altman method and the parameter relationship was explored by linear regression.

**Results:** The relative intra- and interday bias was similar and did not exceed 6%. Relative repeatability of NDrop, FShort and NRise was between 12% and 18% for intraday and between 37% and 38% for interday. Relative repeatability of NDrift and FLen was 27% for intraday and 72% and 75% respectively for interday. Significant relationship was found between NRise and NDrop and between FLen and NDrop ( $p < 0.05$ ), possible relationship was uncovered between NDrift and NDrop and weak relationship was found between FShort and NRise. R2 values were below 0.32.

**Conclusions:** We assessed reliability and relationship of several intrinsic foot motion parameters based on healthy subjects during level walking. Bias was generally low and was not considered relevant for judging reliability. Relative repeatability was the discriminating reliability parameter and allowed comparison. It quantifies the minimal detectable change relative to the expected amplitude of the respective parameter. Repeatability reached larger values for the interday compared with the intraday condition. Medial navicular drift and foot lengthening were found to be less reliable parameters than navicular drop, navicular rise and foot shortening. The limited number of subjects and the fact that the status "healthy" could have bounded the range of values, may be explanations for the relatively poor fit of the linear model.

**Implications:** The regression analysis supports the common notion of foot kinematics during stance: the foot pronates and lengthens while the arch flattens under loading followed by supination and arch rise during push-off. Contrary, a relationship between foot shortening and arch rise during push-off could not have been detected. To decide whether the reliability is sufficient or not, effect sizes must be considered. Minimal changes in navicular drop, foot shortening and arch rise must overcome 20% on the same day and 40% between days in order that the effects are measurable in the evaluated setting.

**Key words:** dynamic foot function; navicular mobility; movement coupling

**Funding acknowledgements:** This work was funded by the Swiss National Science Foundation (Project number 140928).

**Ethics approval:** The study was approved by the ethics committee of the canton of Bern.



## German translation and validation of the postural assessment scale for stroke patients (PASS) in people with acute stroke

Friedemann Berit<sup>1</sup>, Luder Gere<sup>1</sup>, Heldner Mirjam<sup>2</sup>, Arnold Marcel<sup>2</sup>, Verra Martin L.<sup>1</sup>

<sup>1</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland,*

<sup>2</sup>*Inselspital, Bern University Hospital and University of Bern, Department of Neurology, Bern, Switzerland*

**Background:** Stroke is the most common reason for disability in adults. It results in decreasing balance, mobility and increases the risk of falling. Balance deficits reduce daily activities and quality of life, and extend recovery time from stroke. Postural control is necessary to maintain balance in static as well as dynamic activities. It is important to measure balance early to select an optimum therapy, predict ability of independently walking at discharge and evaluate treatment results. The Postural Assessment Scale for Stroke Patients (PASS) is used to assess static and dynamic balance especially for stroke patients in the acute and subacute phase. The PASS contains 12 items: 5 to assess static posture and 7 to evaluate dynamic balance.

**Purpose:** The aim of this study was to translate the PASS into German and investigate the interrater reliability and validity (construct and concurrent validity).

**Methods:** The English version was translated into German according to the international guidelines „Recommendations for the Cross-Cultural Adaptation of the DASH & QuickDASH Outcome Measures“. In this prospective study a total of 62 stroke patients (mean age 64 years; SD 12.7) were recruited maximum ten days poststroke. Twelve patients were assessed at the PASS in the interrater reliability study. All sessions were videotaped so that six additional raters could score them later independently of each other. The validity study included fifty patients. The concurrent validity was studied using the Berg-Balance-Scale (BBS). The BBS originally assessed balance ability and identified the risk of falling. The Construct validity was assessed by Functional- Independence-Measure (FIM) divided into FIM total, locomotion and transfer, just like the original study. The FIM assesses functional physicals (e.g. eating, dressing, walking) and cognitive disability in terms of patient's need for assistance. Statistical analysis included Friedman-Test, Kendall's W and Spearman's rho. The level of significance was set at  $p < 0.05$ .

**Results:** The results showed that the German-PASS demonstrates a high interrater reliability (Kendall's W: one time 0.59 and eleven times  $\geq 0.77$  to 1), an excellent concurrent validity: high Spearman's correlation between PASS and BBS total score ( $r=0.93$ ,  $P < 10^{-16}$ ), static balance ( $r=0.91$ ,  $P < 10^{-16}$ ), dynamic balance ( $r=0.86$ ,  $P < 10^{-15}$ ) and an excellent construct validity: high Spearman's correlation between PASS and FIM total score ( $r=0.85$ ,  $P < 10^{-15}$ ), FIM locomotion ( $r=0.81$ ,  $P < 10^{-12}$ ) and FIM transfer ( $r=0.86$ ,  $P < 10^{-15}$ ). No floor and ceiling effects were observed.

**Conclusions:** The German-PASS is reliable and valid in assessing balance in persons with acute/subacute stroke. It is a useful clinical tool for evaluating static and dynamic balance in inpatients with stroke.

**Implications:** The PASS is an international common assessment in clinical practice and in scientific studies. However, in various stroke units an unvalidated German version is used. Now the PASS can be integrated in daily clinical practice in German-speaking countries. It will enable early recognition of motoric deficits and an individual target and therapy planning will be possible.

**Key words:** PASS; Reliability and Validity; Stroke

**Funding acknowledgement:** This study was supported by the Department of Physiotherapy, Inselspital, Bern University Hospital, Bern, Switzerland.

**Ethics approval:** The study was approved by the Ethics Committee of the Canton of Bern, Switzerland (Reference Number: 244/2015).

## What are the functional benefits of a complementary two-week stochastic resonance whole-body vibration training in patients with acute brain lesion?

Herren Kaspar<sup>1,2</sup>, Schmid Stefan<sup>3</sup>, Rogan Slavko<sup>3</sup>, Radlinger Lorenz<sup>3</sup>

<sup>1</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland*

<sup>2</sup>*SRO Hospital of Langenthal, Langenthal, Switzerland*

<sup>3</sup>*Bern University of Applied Sciences, Health, Bern, Switzerland*

**Background:** Stroke is the major cause for complex disability in adults, whereas traumatic brain injury (TBI) is the most common cause for long-term-disability among young adults. Both conditions represent an enormous socio-economic and healthcare burden. Individuals after stroke or TBI suffer from reduced muscle strength, spasticity, proprioceptive deficits, contractures and impaired balance resulting in gait disorders and therefore reduced independence in everyday life. The use of sinusoidal whole body vibration (WBV) showed promising functional effects in frail elderly, but only inconclusive effects on gait, mobility, balance, spasticity, and strength in stroke patients. Stochastic resonance whole body vibration (SR-WBV) with random vibrations seems to be a safe alternative with low risk factors and low physical strain and therefore a promising option to treat weakness, balance, and mobility particularly in individuals with stroke or TBI.

**Purpose:** It remains unclear whether individuals with stroke or TBI can profit from SR-WBV. Therefore, the aim of this study was to investigate the impact of complementary SR-WBV on muscle strength, gait performance, and balance ability.

**Methods:** This study was designed as a single-blind prospective randomized controlled trial. The major inclusion criterion was the clinical diagnosis of an acute first-ever unilateral brain lesion by means of stroke or TBI. Forty-eight individuals were randomly allocated to a verum (VG) or a sham group (SG), which received an individual conventional neurological rehabilitation and additionally 5 series of SR-WBV lasting 60s daily. The VG trained in a standing position with 5Hz, while the SG was vibrated with 1 Hz sitting on a box. Maximum strength and rate of force development of the paretic leg (knee extension), balance (semi-tandem stance) and gait performance (10m gait test) were measured at baseline (pre), immediately after the first SR-WBV session (post 1) for short and after two weeks (post 2) for long term effects. To investigate short (pre / post 1) and long term effects (pre / post 2), the Wilcoxon signed-rank test was used. Between groups comparisons were conducted using the Mann-Whitney U test. Alpha-level was Bonferroni-corrected.

**Results:** No statistically significant between-group differences were found at pre, post 1 and post 2. Within-group comparisons revealed short term main effects for gait velocity, step length and stance phase on the affected and unaffected sides in both groups. Long term effects for strength parameters were found as a distinct increase in MVIC (VG) and a reduction of sway and sway velocity in the SG. Both groups improved regarding gait velocity, step length and stance phase of the affected and unaffected legs.

**Conclusion(s):** Individuals after stroke or TBI did not show any benefits regarding muscle strength, gait performance or balance ability from two weeks of SR-WBV treatment that was carried out in addition to conventional neurological rehabilitation. However, future studies should investigate longer intervention periods, since two weeks might not have been sufficient to cause any measurable effects.

**Implications:** Although complementary SR-WBV showed no effects on daily living tasks, it might be used as an additional therapeutic low-risk modality.

**Key words:** stroke; traumatic brain injury; whole-body vibration

**Funding acknowledgements:** Swiss National Science Foundation (No. 13DPD6\_127280)

**Ethics approval:** The study protocol was approved by the local Ethics Committee of the Canton of Bern, Switzerland (Reference No. 225/08).

# Exercise and other non-pharmaceutical interventions for cancer-related fatigue in patients during or after cancer treatment: systematic review and indirect-comparisons meta-analysis

Hilfiker Roger<sup>1</sup>, Meichtry André<sup>2</sup>, Eicher Manuela<sup>3</sup>, Nilsson Balfe Lina<sup>4</sup>, Knols Ruud<sup>5</sup>, Verra Martin L.<sup>6</sup>, Taeymans Jan<sup>7</sup>

<sup>1</sup>HES-SO Valais-Wallis, School of Health Sciences, Leukerbad, Switzerland

<sup>2</sup>Zurich University of Applied Sciences, Zürich, Switzerland, <sup>3</sup>Institute of Physiotherapy, Zürich, Switzerland

<sup>3</sup>Faculty of Biology and Medicine, University of Lausanne, Institute of Higher Education and Nursing Research, Lausanne, Switzerland

<sup>4</sup>University of Applied Sciences and Arts Western Switzerland Valais, Leukerbad, Switzerland, School of Health Sciences, HES-SO Valais-Wallis, Leukerbad, Switzerland

<sup>5</sup>University Hospital Zurich, Zurich, Switzerland, Directory of Research and Education, Physiotherapy Occupational Therapy Research, Center, Zürich, Switzerland

<sup>6</sup>Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland

<sup>7</sup>Bern University of Applied Sciences, Health, Physiotherapy, Switzerland

**Background:** Cancer related fatigue is one of the most common and distressing symptoms of cancer and cancer treatment that can be prevalent before treatment onset and usually increases during therapy. There is a broad variety of non-pharmacological treatments against CRF. However, it is still unclear which of these anti CRF treatment modalities yield the largest treatment effect. In this paper we focused on exercise related non-pharmacological interventions, such as physical activity, aerobic and resistance training, and relaxation, while nutritional interventions were excluded.

**Purpose:** This indirect-comparisons meta-analysis aimed to assess the relative effects of different types of exercise and other non-pharmacological interventions on cancer-related fatigue in patients during and after cancer treatment.

**Methods:** Articles were searched in PubMed, Cochrane CENTRAL and published meta-analyses. Randomized studies published from inception to November 2015 evaluating different forms of exercise or other non-pharmacological interventions to reduce CRF in any cancer type during or after treatment. Risk of bias assessment with PEDro criteria and random effects Bayesian network meta-analysis.

**Results:** We included 215 studies. Comparing the treatments versus usual care during cancer treatment, relaxation exercise had the highest Standardized Mean Difference (SMD) -0.76 (95% Credible Interval (CrI) -1.06 to -0.46) while Yoga (SMD -0.65 (-1.02 to -0.28), cognitive behavioural therapy combined with physical activity (combined CBT, SMD -0.65 with 95% CrI -1.07 to -0.23) and resistance training (SMD -0.63 with 95% CrI -1.01 to -0.26) all had moderate to large SMDs. After cancer treatment, Yoga showed the highest effect (SMD -0.64 with 95% CrI -0.92 to -0.37). Combined aerobic and resistance training (SMD -0.49 with 95% CrI -0.68 to -0.31), CBT (SMD -0.48 with 95% CrI -0.69 to -0.27), combined CBT (SMD -0.46 with 95% CrI -0.74 to -0.19) and Tai-Chi (SMD -0.45 with 95% CrI -0.86 to -0.05) showed all moderate SMDs.

**Conclusion(s):** During cancer treatment: Relaxation, Yoga, Cognitive behavioural therapy (CBT) combined with physical activity, aerobic and resistance training (alone or combined) were able to reduce cancer-related fatigue, showing moderate to large effect sizes. After cancer treatment: Yoga showed a large effect size for the reduction of cancer-related fatigue, while combined aerobic and resistance training, cognitive behavioural therapy (CBT) alone or combined with physical activity, Tai-Chi as well as aerobic or resistance training alone all showed moderate effect size.

**Implications:** For clinical decision-making, our rankings of interventions to reduce CRF provide evidence-based choices and allow to target them to patients under treatment and patients having completed chemotherapies / radiotherapies. During cancer treatment, relaxation exercises and Yoga might be the first choice to manage cancer-related fatigue. After cancer treatment, the clinician might encourage more physical activity enhancing interventions. Patient and health care professionals can now choose out of a variety of evidence based non-pharmaceutical interventions according to patients' preference and abilities in order to tackle cancer related fatigue.

**Key words:** Cancer related fatigue; Exercise; Network Meta-Analysis

**Funding acknowledgements:** This study was funded by physioswiss (Swiss physiotherapy association) and the University of Applied Sciences and Arts Western Switzerland HES-SO.

**Ethics approval:** not required.

## **Crosstalk considerations in studies evaluating pelvic floor muscles using surface electromyography in women: a scoping review**

Koenig Irene<sup>1</sup> & Flury Noémie<sup>1</sup>, Radlinger Lorenz<sup>1</sup>

<sup>1</sup>*Bern University of Applied Sciences, Health, Bern, Switzerland*

**Background:** Surface electromyography (sEMG) using intravaginal probes is of widespread use for assessing pelvic floor muscles (PFM) activity in women. Although considered as a reliable method, its validity has been called into question due to the presence of a phenomenon called crosstalk. Crosstalk is described as the recording of sEMG activity originating from neighboring muscles rather than coming exclusively from the muscles being investigated.

**Purpose:** The purpose of this review was to provide an overview of existing literature about crosstalk during intravaginal surface electromyographic recordings.

**Methods:** A scoping review was performed according to the Arksey and O'Malley framework. An electronic search was conducted on six relevant databases. Additionally, authors were directly contacted to identify grey literature. Data extraction consisted of descriptive numeric analysis as well as thematic analysis, which were conducted by two independent reviewers.

**Results:** Forty-nine references written by 34 authors coming from 13 different countries constitute the body of evidence of the present review. Eight main themes have been identified through the thematic analysis. The included material varies greatly in terms of methodology, approach to the crosstalk problem and depth of analysis.

**Conclusions:** A gap in knowledge affecting the validity of the current sEMG investigation methods was identified. Literature addressing the crosstalk problem is scarce and often flawed. Definitive conclusions are regularly drawn from an insufficient basis of evidence.

**Implications:** Further research is therefore deeply necessary, although it remains unclear whether this issue can be solved at all with current technology.

**Key words:** Urinary Incontinence, Intravaginal Probes, Physical Therapy Modalities

**Funding acknowledgements:** None

**Ethics approval:** For this type of study formal consent is not required.

Irene Koenig and Noémie Flury are both first authors.

# Wavelet analysis of muscle activity of lower extremities and pelvic floor muscles in women while walking or running: A systematic review

Koenig Irene<sup>1,2</sup>, Blasimann Angela<sup>1</sup>, Hauswirth Antonia<sup>1</sup>, Eichelberger Patric<sup>1</sup>, Baeyens Jean-Pierre<sup>2</sup>, Radlinger Lorenz<sup>1</sup>

<sup>1</sup>Bern University of Applied Sciences, Health, Bern, Switzerland

<sup>2</sup>Vrije Universiteit Brussel, Faculty of Physical Education and Physiotherapy, Belgium

**Background:** Pelvic floor muscles (PFM) must be able to contract reflexively given that sneezing and coughing provoke an expeditious intra-abdominal increase in pressure, whereupon PFM must react. Furthermore, reflex activity is also needed during whole body movements with a high impact load such as running or jumping. Consequently, a better understanding of muscle fiber recruitment and the timing of PFM contraction would support the understanding of how PFM function contribute to continence. PFM electromyography (EMG) is a commonly used method to assess PFM function. Conventional EMG analyses of rectified signals or root mean squared values provide information about timing and intensity of muscle activity without considering frequency components. The gain of a wavelet approach is to provide simultaneous information in the domains of time, frequency and magnitude.

**Purpose:** This systematic literature review regarding wavelet functions to analyze EMG muscle activity patterns of the lower extremity (or PFM if available) during walking or running will help find an appropriate wavelet application to analyze PFM EMG patterns derived from women performing dynamic impact activities in further studies.

**Methods:** This systematic review is listed in the international prospective register of systematic reviews (PROSPERO) with the identification number CRD42016035986. The composition was based on the PICO model and the PRISMA checklist. Eleven relevant electronic databases were systematically searched until March 28<sup>th</sup> 2016. Additionally, congress proceedings as well as reference lists were scanned. The quality of the included studies and the risk of bias were analyzed with "The Cochrane Collaboration`s tool for assessing risk of bias". The following data were extracted: first author, year, subject characteristics, intervention, outcome measures & variables, results and wavelet specification.

**Results:** In this review, 20 studies were included. In 18 studies EMG activity patterns of the lower extremities were investigated. Furthermore, two conference proceedings analyzing PFM were found. The included studies analyzed three different main objectives: The recognition rate, time period characteristics and fiber recruitment patterns. The recognition rate of the EMG of muscles of the lower extremity varied between 68.4% and 100%. However, the rate of false discrimination was 4% discriminating maximum voluntary contraction of healthy from weak PFM. The evaluation of muscle timing, time shifts and early or delayed muscle activation showed differences in the activation patterns of walking compared to running, as well as healthy people compared to patients. Atrophic muscles did not produce the high frequency type II fiber components but more energy in their lower frequencies.

**Conclusions:** Wavelets reflect signal components related to activities of slow type I fibers, fast type II firing rate fibers and also muscle timing characteristics. This information is needed to support the understanding of how PFM dysfunction contributes to incontinence regarding pre-activation and reflex circles. Therefore, a wavelet approach is appropriate for PFM EMG analysis.

**Implications:** Although wavelet analysis is well established in the field of biomechanics, only two conference proceedings were found analyzing PFM EMG with wavelets. However, this knowledge would allow optimizing the training protocols of PFM rehabilitation. Therefore, PFM EMG wavelet analysis while running will be performed in future projects.

**Key words:** Electromyography, Urinary incontinence, Reflex, Timing

**Funding acknowledgements:** None

**Ethics approval:** For this type of study formal consent is not required.

## Development of the international classification of functioning, disability and health incontinence assessment form (ICF-IAF)

Kuhn Manuel<sup>1,2</sup>, Gass Stephanie<sup>3</sup>, Radlinger Lorenz<sup>3</sup>, Köhler Barbara<sup>1,2</sup>

<sup>1</sup>Zurich University of Applied Sciences, Health, Winterthur, Switzerland

<sup>2</sup>Stadtspital Triemli, Zurich, Switzerland

<sup>3</sup>Bern University of Applied Sciences, Health, Berne, Switzerland

**Background:** There is lack of questionnaires to evaluate urinary (UI) and faecal incontinence (FI) including all aspects of the bio-psycho-social model of the World Health Organisation (WHO). Current questionnaires only focus on problems (barriers) and do not evaluate resources (positive influencing factors) for planning and evaluation of effective interventions in multi-professional settings. Previous development of the ICF-IAF included the analysis of current disease specific questionnaires as well as Delphi-technique survey among 262 physiotherapists in 5 German speaking countries. Single persons' interviews with patients are ongoing.

**Purpose:** The purpose of this subproject was to identify problems (barriers) and resources (positive influencing factors) of affected people on the basis of the ICF and to amend the development of the ICF-IAF.

**Methods:** Gender dependent focus group interviews were done including 3-6 patients per focus group using semi-structured interviews based on the chapters of the ICF. Answers were linked to the ICF categories by two researchers. Kappa statistics was done. Saturation was defined by linking no more than 5 new categories in the interview.

**Results:** Over all 8 focus group interviews (f 4 / m 4) were conducted with 26 participants (f 13 / m 13). **Problems (barriers)** could be linked to the ICF on the 2nd ICF-Level (f 152 / m 108) as well as **resources (positive influencing factors)** on the 2nd ICF-Level (f 123 / m 66). Cohen's Kappa between the two linking persons on the 2nd ICF-level was f 0.45 / m 0.58. The number of participants reached the predicted saturation.

**Conclusions:** Problems are the key component of current disease specific questionnaires. Resources seem to be an important factor from the patients' perspective and should not be neglected in the assessment and evaluation of UI and FI. Limitations were the average age of the participants (f 70 / m 75), the participants' previous experience with health professionals because of their incontinence, and the focus on urban population from one country in central Europe.

**Implications:** The results of this study will influence the consensus conference in November 2017, which will enable the dissemination of the ICF-IAF within the international community. Currently, the more than 90 translations of the ICF and the serially numbered coding system allow **immediate world-wide use** after the conference and will help to standardize therapy and research protocols.

**Key words:** ICF; incontinence; assessment

**Funding acknowledgements:** No funding. We thank Astrid Schaemann, Markus Wirz, Madeleine Isler, Irene Koenig, Pascale Brand, and all patients for their support.

**Ethics approval:** Ethics Committee of Zurich Switzerland: KEK-ZH-Nr 2015-0257, Ethics Committee of Bern Switzerland: EK BE 126/2015.

## Effect of resistance training in women with joint hypermobility – results of a pragmatic randomized controlled trial

Luder Gere<sup>1,2</sup>, Mueller Mebes Christine<sup>1</sup>, Haupt-Bertschy Bettina<sup>1</sup>, Verra Martin L.<sup>1</sup>, Aeberli Daniel<sup>3</sup>, Baeyens Jean-Pierre<sup>2</sup>

<sup>1</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland*

<sup>2</sup>*Vrije Universiteit Brussel, Physical Education and Physiotherapy, Brussels, Belgium*

<sup>3</sup>*Inselspital, Bern University Hospital and Bern University, Department of Rheumatology, Clinical Immunology and Allergology, Bern, Switzerland*

**Background:** Little is known about the management of persons with generalized joint hypermobility (GJH). Affected persons are often restricted in performing sports or leisure activities, as well as during work, due to pain and disability. Adequate muscle strength for movement control might be an important issue to overcome these restrictions. Resistance training has the possibility to improve muscle strength, but so far no study examined the influence of resistance training on strength and muscle size in women with GJH.

**Purpose:** The main goal was to investigate the effects of a 12 week resistance training in women with GJH on strength and muscle size. Additionally the influence on daily function and disability was investigated.

**Methods:** This RCT included 51 hypermobile women (mean age 26.5, sd 4.5 years) with a Beighton-score of six or more. 27 women performed a structured resistance training twice weekly for 12 weeks and 24 women did not exercise. Outcome measurements included maximum isometric strength (MVC) of knee extensors and flexors, muscle cross-sectional-area (mCSA) of the thigh at 33% above knee and the self-reported questionnaire SF-36. Data were analysed on an intention-to-treat basis using MANOVA with a significance level of  $p=0.05$ . Results are presented as mean difference between groups with 95% confidence intervals (CI) and the respective effect size (es).

**Results:** Both groups were comparable at baseline. The MANOVA revealed no significant difference in any of the five main variables. The difference of change between groups for maximum knee extensor strength was 43.9 N (CI -4.2 to 92.2,  $es=0.36$ ), for knee flexors 29.2 N (CI -5.9 to 64.18,  $es=0.33$ ) in favour of the training group. Regarding mCSA mean difference of change was 131.2 mm<sup>2</sup> (CI -13.0 to 275.3,  $es=0.37$ ) in favour for the training group. Concerning the SF-36 for the physical component summary score mean difference of change was 0.5 (CI -1.6 to 2.6,  $es=0.09$ ) and for the mental component summary -4.2 (CI -0.8 to -7.5,  $es=0.50$ ), thus favouring the control group.

**Conclusions:** The 12-week resistance training did not change isometric knee muscle strength or mCSA of the thigh in women with GJH. High standard deviations were seen, illuminating the high variability between the subjects in both groups, and maybe responsible for the non-significant result. Another possible reason for the lack of measured difference in strength might be that training was dynamic, while the measurement was isometrically. Furthermore, the analysis of the training protocols showed that several of the study participants did exercise with low resistance. As example in unilateral leg press the mean resistance of all women who exercised was 83% of body weight (range 65-160%) in the last training session. Therefore only three instruction sessions during the 12 weeks were probably insufficient to gain muscle mass and to keep motivation to exercise at the personal strength limit.

**Implications:** Resistance training did not clearly change strength and muscle mass in women with GJH. Maybe they need closer supervision and guidance during training to keep motivation and to use enough resistance for a clear gain in muscle strength and muscle mass.

**Key words:** generalized joint hypermobility; strength training; exercise prescription

**Funding acknowledgements:** No external financial support was given for this study.

**Ethics approval:** The study was approved by the Ethics Committee of Canton Bern (222/12). The trial is registered as ISRCTN9022454.

## Resistance training in women: influencing factors and differences versus men – systematic review of the literature

Luder Gere<sup>1</sup>, Kraehenbuehl Myrtha M.<sup>2</sup>, Liechti Melanie N.<sup>2</sup>

<sup>1</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland*

<sup>2</sup>*Bern University of Applied Sciences, Health, Physiotherapy, Switzerland*

**Background:** Resistance training (RT) is frequently used as treatment in physical therapy, e.g. in persons with osteoarthritis of the knee or hip, for patients with low back pain or after orthopedic surgery. In general the aims are gains in strength and muscle mass, as well as improvements in functional movements and better performance of daily life activities. Usually in the recommendations no difference is made between women and men. However, there are important differences in terms of muscle mass and body composition, in hormone levels and hormonal changes, as well as in psychological factors. Thus it might be important to know differences in the response to RT between women and men for the individual adaptation of prescription and instruction during physical therapy.

**Purpose:** The aim of this review was to identify influencing factors on gain in strength and muscle mass by resistance training in healthy women and to compare women and men in terms of these gains.

**Methods:** A systematic literature search was performed in PubMed, CINAHL, Embase and SPORTDiscus for studies between January 2000 and April 2016. Included were studies investigating strength or resistance training of at least six weeks in women between 18- 40 years, which included only women or compared women and men as separate groups. Study quality was rated with the Cochrane risk of bias tool.

**Results:** Totally 174 studies were screened and finally 13 studies were included in the review. All studies showed high or middle risk of bias, mainly due to lacking of randomization and blinding and because of researching small groups. Eight of the studies looked at influencing factors to the training and five trials were investigating differences between women and men. Factors influencing the response to RT were menstrual cycle, training intensity and duration, as well as type of training. Compared to men, women displayed in general higher relative increase of strength and muscle mass by RT, but lower absolute changes by the training.

**Conclusions:** The evidence level in this field is low, mainly because of the poor quality of the studies. The results of the studies were difficult to compare because of different types of training, different outcome measurements and various duration of the training period. Influencing factors were rarely reported separately for women and men, except for menstrual cycle. No studies were found looking at motivation and other psychological factors. In general, there are differences between women and men in the response to RT. The higher relative increases may reflect the lower starting level of the women.

**Implications:** No clear recommendation can be given at this time, based on the actual studies concerning influencing factors. Differences in absolute and relative strength gain must be considered when performing and assessing RT with women. More research is needed concerning influencing factors in women doing RT, i.e. the monthly hormonal changes, best type and duration of training and also motivational factors.

**Key words:** muscle strength; muscle mass; menstrual cycle

**Funding acknowledgements:** No external financial support was given for this study.

**Ethics approval:** No ethical approval was necessary for this review of the literature.



## **Involuntary reflexive versus standard voluntary pelvic floor muscle training: RCT protocol testing a new therapy concept for stress urinary incontinence**

Luginbuehl Helena<sup>1,2</sup>, Lehmann Corinne<sup>3</sup>, Baeyens Jean-Pierre<sup>2</sup>, Kuhn Annette<sup>4</sup>, Koenig Irene<sup>1</sup>, Radlinger Lorenz<sup>1</sup>

<sup>1</sup>*Bern University of Applied Sciences, Health, Physiotherapy, Switzerland*

<sup>2</sup>*Vrije Universiteit Brussel, Faculty of Physical Education and Physiotherapy, Belgium*

<sup>3</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland*

<sup>4</sup>*University Hospital and University of Bern, Department of Gynaecology, Woman's Hospital, Berne, Switzerland*

**Background:** Pelvic floor muscle (PFM) training is effective and recommended as first-line therapy for female patients with stress urinary incontinence (SUI). However, standard PFM physiotherapy concentrates on voluntary contractions although the situations provoking SUI require involuntary fast reflexive PFM contractions. To date, the focus of research on PFM function has been on the concentric and isometric muscle action leading to the lift and squeeze but so far no light has been shed on the eccentric or eccentric-concentric type of contraction and the related involuntary or reflexive power. Such training procedures are widely implemented in rehabilitation and sports but not yet in pelvic floor rehabilitation.

**Purpose:** Therefore, the aim of this study was to develop a training protocol including standard physiotherapy and in addition focusing on involuntary reflexive pelvic floor muscle contractions and to prepare a RCT study protocol comparing this newly developed physiotherapy program (experimental group) and the standard physiotherapy program (control group) regarding their effect on female SUI.

**Methods:** The PFM training protocol follows the progression of training for motor learning, strength, hypertrophy and power training phases according to the training principles variation/ periodization, muscle action and velocity of muscle action, loading, volume, exercise selection, rest periods and frequency for both groups. The intervention lasts 16 weeks including 9 personal physiotherapy consultations and 78 short home training sessions (weeks 1-5 3x/week, 3x/day; weeks 6-16 3x/week, 1x/day). Thereafter both groups will continue with home training sessions for 6 months. The working hypothesis is that the experimental group focusing on involuntary reflexive muscle contractions will have a higher improvement of continence measured by the International Consultation on Incontinence Modular Questionnaire Urinary Incontinence (short form) (ICIQsf), and, regarding secondary and tertiary outcomes, higher electromyography PFM activity during SUI provoking activities (running at different speeds, squat jump, countermovement jump, drop jump), better pad-test results, higher quality of life scores (International Consultation on Incontinence Modular Questionnaire (ICIQLUTsqol) and higher intravaginal muscle strength (digitally tested) from before to after intervention phase. This study is designed as a prospective, triple-blinded, RCT with two physiotherapy intervention groups with a 6-month follow-up including 48 stress urinary incontinent women per group. To compare the primary outcome, ICIQsf between and within the two groups at ten time points (before intervention, physiotherapy sessions 2-9, after intervention) ANOVA models for longitudinal data will be applied.

**Results:** The RCT study protocol for testing involuntary reflexive versus standard voluntary PFM training was registered (NCT02318251) and received ethics committee approval (Ethics Committee of the Canton of Bern reference number 249/14) with the first participant included in March 2015.

**Conclusions:** This study closes a gap, as it presents a novel SUI therapy regimen including involuntary reflexive PFM training.

**Implication(s):** The current guidelines for physical therapy in patients with SUI do not contain PFM involuntary reflex training. Consequently, should this therapy protocol including involuntary reflexive PFM training in addition to standard training prove more effective than standard training alone, this would be of high clinical and practical relevance and implementation could follow immediately.

**Key words:** pelvic floor, reflex, exercise

**Funding acknowledgements:** Funded by: Swiss National Science Foundation (SNSF; (320030\_153424/1). The granting SNSF is not involved in the study protocol and conduct.

**Ethics approval:** not applicable; RCT study approved by Ethics Committee of the Canton of Bern, Switzerland (249/14)

## Symptoms in daily life and activity level of women with and without hypermobility

Mueller Mebes Christine<sup>1</sup>, Luder Gere<sup>1,2</sup>, Schmid Stefan<sup>2</sup>, Stettler Matthias<sup>2</sup>, Stutz Ursula<sup>1</sup>, Radlinger Lorenz<sup>2</sup>

<sup>1</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland*

<sup>2</sup>*Bern University of Applied Sciences, Health, Discipline Physiotherapy, Berne, Switzerland*

**Background:** Benign generalized joint hypermobility (BGJH) depends on age, sex and ethnicity, whereby women are usually more often affected than men and, with increasing age, joint mobility is commonly reduced. In a recent survey conducted by Mulvey et al., the prevalence of BGJH in a general population was reported to be 18% with hypermobile subjects having a 40% increased risk of reporting severe chronic widespread pain. Furthermore, recurrent joint dislocation or subluxation, arthralgia, soft tissue injuries, fibromyalgia, chronic fatigue syndrome, risk for early osteoarthritis as well as back pain, reduced activity level in sports and reduced strength.

**Purpose:** The aim of the current study was to record specific problems and disorders of hypermobile women and to investigate the activity level of hypermobile women compared to women with normal mobility.

**Methods:** A total of 195 women, 67 normomobile (NM) and 128 hypermobile, whereof 56 were further classified as hypermobile with symptoms (HM-s) and 47 as hypermobile without symptoms (HM-as) were included in this explorative study. Symptoms were first recorded with the Canadian Occupational Performance Measure (COPM) and then monthly over a period of 6 months with a face validated questionnaire including a general overview of impairment, the localization, type, intensity and frequency of problems. Activity level was determined by the International Physical Activity Questionnaire (IPAQ) [4].

**Results:** Concerning COPM there was no significant difference between patients in the NM and HM group. In the face validated questionnaire pain in different localization by remaining in a position was mentioned as most important problem. The highest activity level showed the HM-s group compared to NM ( $p=0.028$ ).

**Conclusion:** There seem to be differences in symptoms and activity level between hypermobile and women with normal mobility. Though the hypermobile women were classified as BGJH half of them were complaining about pain. Therefore a more comprehensive procedure of screening, and a more specific investigation may help to evaluate the finely graduated differences between the groups.

**Implications:** The evaluation of the complex clinical pattern of BGJH in more detail would make a more individual treatment possible.

**Key words:** Benign generalized hypermobility, symptoms, activities in daily life

**Funding acknowledgements:** This work was funded by the Swiss National Foundation (13DPD6\_127285).

**Ethics approval:** The study was approved by Ethics Committee of the Canton of Bern, Switzerland

## The influence of gait and speed on the dynamic navicular drop - a cross-sectional study on healthy subjects

Pohl Johannes<sup>1</sup>, Eichelberger Patric<sup>1,2</sup>, Baur Heiner<sup>1</sup>

<sup>1</sup>Berne University of Applied Sciences, Health, Physiotherapy, Switzerland

<sup>2</sup>Graduate School for Cellular and Biomedical Sciences, University of Bern, Switzerland

**Introduction:** Variations of gait speed influence kinematic variables that may have an effect on dynamic foot deformation. The influence of gait speed on the navicular drop (ND) has not yet been investigated.

**Method:** The ND was evaluated in static ( $ND_{st}$ ) and dynamic ( $ND_d$ ) conditions using a 3D-motion capture system.  $ND_d$  was dynamically evaluated on a treadmill performing three different walking and running velocities for two minutes each. A repeated measures ANOVA and post hoc pairwise t-tests were conducted to evaluate the differences of the  $ND_d$ , the corresponding unloaded navicular height pre stance ( $NH_{ps}$ ) and loaded navicular height during stance ( $NH_s$ ) for different conditions.

**Results:** A total of twenty healthy participants (male,  $n = 15$ ; female,  $n = 5$ ) were analysed. Higher walking speed led to a significant decrease in  $NH_{ps}$  and a subsequent decrease of  $ND_d$  ( $p < .001$ ). Across increasing running velocities,  $NH_s$  was significantly decreased which eventually led to an increased  $ND_d$  ( $p < .001$ ). For walking and running at the same speed, there was a large effect of gait style with an increase of  $ND_d$  by 3.52 mm ( $p < .001$ ) during running. Compared to  $ND_{st}$ ,  $ND_d$  was increased by 274% within walking 1.67 m  $s^{-1}$  and by 504% for running at 1.67 m  $s^{-1}$ .

**Conclusion:** The change of gait from walking to running at the same speed had a large effect on  $ND_d$ . The values of unloaded NH and minimal NH should be taken into account for the interpretation of dynamic ND measures. Static and dynamic ND measures differ substantially.

**Key words:** navicular height, static navicular drop, gait speed, barefoot kinematics, 3-D motion capture.

**Funding acknowledgements:** This work was funded by the Swiss National Science Foundation (Project number 140928).

**Ethics approval:** The study was approved by the ethics committee of the canton of Bern.

## Impact of ankle joint mobilization on time-to-stabilization and on the peroneus longus muscle activity – a single case study

Rogan Slavko<sup>1</sup>, Zuber Stefan<sup>1</sup>, Jost Karin<sup>1</sup>, Stuker Nadine<sup>1</sup>, Zimmerli Tabea<sup>1</sup>, Eichelberger Patric<sup>1</sup>

<sup>1</sup>*Bern University of Applied Sciences, Health, Physiotherapy, Switzerland*

**Background:** Acute ankle distorsion traumas are common sport injuries and 20 to 40% of them lead to chronic ankle instability. The literature described for patients with CAI a reduced postural control and reduced muscle activity. Treatment recommendation includes sensorimotor training and strength training. Recently, manual therapy techniques were used to improve range of motion and to stimulate receptors in the joint capsule and muscle-tendon complex to increase proprioception with the aim to enhance postural control and muscle activity. However, this hypothesis shows a heuristic nature. Empiric investigation should be implemented, to formulate first hypothesis and subsequently these hypotheses should be verified and falsified, respectively. For this reason, a single case study was carried out.

**Purpose:** The aim of this single case study was to evaluate the influence of an ankle joint mobilization on the time-to-stabilization (TTS; postural control) and on the neuromuscular activity of the peroneus longus muscle (PL) during the landing and stabilization phase after a single drop jump.

**Methods:** A single case study was used in the preliminary stage of an investigation to generate hypotheses, which are subsequently planned to be systematically tested with a larger number of participants. A 32-year-old female with chronic ankle instability on the right foot was included. Based on the physical examination, different manual mobilization techniques were applied during ten minutes. Ten single leg jumps were performed on a force plate. TTS was measured based on stability criteria extracted from ground reaction forces in vertical, anterior/posterior and medial/lateral direction were. PL neuromuscular activity was analyzed from surface electromyography signals in a time windows relative to the landing time point of -30 to 0, 0 to 30, 30 to 60, 60 to 90, 90 to 120 and 120 to 150 ms.

**Results:** The TTS after joint mobilization were significantly reduced ( $p < 0.05$ ). A trend towards increased activity was determined for PL activity at 90 to 120 ms (Baseline: 32.53 mV, post: 40.23 mV;  $p = 0.049$ ).

**Conclusions:** Beneficial effects of manual ankle joint mobilization on a reduced TTS and improved PL muscle activity could be identified due to a possible optimal reflex outflow from the proprioceptors and alpha-moto-neurons. Further studies have to elaborate this hypothesis. The functional approach of ankle joint mobilization appears to be promising.

**Implications:** The results indicate potential to reduced TTS and altered neuromuscular activity after manual ankle joint mobilization.

**Key words:** chronic ankle injury, electromyography, postural control

**Funding acknowledgements:** No external funding

**Ethics approval:** none, because single case studies do not need an ethic approval in Switzerland.

## Effects of hip abductor muscles exercises on pain and function in people with patellofemoral pain: a systematic review and meta-analysis

Rogan Slavko<sup>1</sup>, Hähni Michaela<sup>1</sup>, Taeymans Jan<sup>1</sup>

<sup>1</sup>Bern University of Applied Sciences, Health, Physiotherapy, Switzerland

**Background:** Treatment of patellofemoral pain (PFP) focuses on the neuromuscular control of the knee. An extensive systematic review on the treatment effects of proximal exercises (e.g. strengthening of quadriceps muscle, hip muscles and abdominal muscles) on PFP, observed high between study effect size heterogeneity which did not allow for pooling of the data.

**Purpose:** To conduct a systematic review and meta-analysis by focusing on the role of the gluteal muscles only in the management and therapy of PFP. The aims of this study were (i) to assess the effect of hip muscle strengthening compared to no hip muscle strengthening training and (ii) to estimate the effect of hip muscle strengthening compared to knee muscle strengthening on pain and function in patients with PFP.

**Methods:** Eligible studies examining the impact of strengthening of hip abductor muscles, no hip muscle exercise or knee muscle exercise on pain and functional status were selected in six databases. The Cochrane risk of bias tool was used to assess procedural quality. Trial registration: PROSPERO 2014:CRD42014010716.

**Results:** Seven RCT studies and one non-RCT study were included totaling 291 participants. The studies showed on average a low methodological quality. Hip exercise revealed greater pain reducing effects (Hedges'  $g = -1.2$ , 95% CI: - 2.2 to - 0.2) as compared to no hip exercise and as compared to knee muscle training (Hedges'  $g = -0.7$ , 95% CI: - 1.7 to 0.2). After re-expression in the original metric, these effect sizes translate into a reduction by 1 to 2 cm on the 10 cm VAS pain scale. The effectiveness on functional impairment in the hip exercise group compared to the no hip exercise, revealed a Hedges'  $g = -1.5$  (95% CI: - 3.1 to 0.01). Compared to knee muscle training this effect was Hedges'  $g = -0.9$  (95% CI: - 2.0 to 0.3), indicating functional improvement after hip strength exercise. Clinically, this finding is consistent with a reduction by about 20 units on the Lower Extremity Functional Scale (LEFS). In this review more studies assessing open-chain hip exercises than closed-chain hip exercises were included. Both training methods showed similar improvements in functional status and hip muscle strength.

**Conclusions:** The results of the meta-analysis showed evidence that strength training of the hip abductor muscles compared to no hip muscle training had a strong and statistically significant effect on pain and function in patients with PFP. Furthermore, hip muscle training compared to knee muscle training showed also clinically relevant effect-sizes on pain and function in patients with PFP (albeit not statistically significant).

**Implications:** Open-chain hip exercises as well as closed-chain hip exercises showed clinically relevant improvements in functional status and hip muscle strength.

**Key words:** hip strengthening, runner's knee, anterior knee pain, function

**Funding acknowledgements:** None

**Ethics approval:** None

## **Systematic review on applications, indications, and effects of passive hydrotherapy WATSU (WaterShiatsu)**

Schitter Agnes M<sup>1</sup>, Fleckenstein Johannes<sup>1,2</sup>, Frei Peter<sup>3</sup>, Taeymans Jan<sup>4</sup>, Kurpiers Nico<sup>3</sup>, Radlinger Lorenz<sup>4</sup>

<sup>1</sup>*Institute of Complementary Medicine, University of Bern, Switzerland*

<sup>2</sup>*Department of Sports Medicine, Institute of Sports Sciences, Goethe-University Frankfurt, Germany*

<sup>3</sup>*Institute of Sport Science, University of Hildesheim, Germany*

<sup>4</sup>*Bern University of Applied Sciences, Health, Physiotherapy, Switzerland*

**Background:** To practice WATSU (WaterShiatsu), a therapist stands in 35° C water, moving a client in slow and spacious circular motions. Gentle tractions applied to the client's body are supposed to stretch muscular and fascial structures, and to stimulate meridians, i.e. channels through which according to Traditional Chinese Medicine the life-energy "qi" (氣) is flowing. Developed in the 1980's, WATSU is now practiced worldwide and occasionally reported to be implemented in therapeutic settings.

**Purpose:** Objective of this first systematic literature review (PROSPERO registration number CRD42016029347) on WATSU is to build a foundation for research on this topic by providing a comprehensive overview of the currently evident knowledge on its use and attributed effects.

**Methods:** The search without language restrictions for the terms "watsu OR watershiatsu OR (water AND shiatsu)" was conducted in 23 databases and manually in reference lists of retrieved publications. Authors of recent publications on WATSU, as well as Institutes of Aquatic Bodywork, were contacted to retrieve additional grey literature. All procedures of data collection, screening, inclusion, risk of bias assessment, and data extraction were performed by two independent reviewers. Qualitative information on applications, indications, and effects of WATSU was extracted from the entire body of evidence. Quantitative results concerning effects of WATSU as a stand-alone hydrotherapy delivered in adequate water temperatures (33°-36° C), reported in peer reviewed original articles (regardless of study design), were submitted to risk of bias-assessment.

**Results:** The search yielded 1,248 articles (without duplicates), of which 459 actually reported on WATSU. Peer reviewed articles were divided into original articles (n=56) and secondary literature (n=74). In 32 of the original articles, elements of WATSU were integrated in hydrotherapeutic programs. Fourteen studies reported on quantitative outcomes regarding effects of genuine WATSU, covering a broad spectrum of indications (e.g. pain, hemiplegia, asthma, depression, or pregnancy). Their overall risk of bias, due to study design (1 random controlled trial, 2 controlled trials, 2 trials without control group, 6 case series, and 3 case reports) and room for improvement in reporting, is high. WATSU was reported to be applied on individuals from childhood to seniority. The intervention aimed for physical (e.g. regarding pain, range of motion, physical quality of life) or mental (e.g. regarding stress, depression, mental quality of life) benefits.

**Conclusions:** This systematic review supports the notion that WATSU is being attributed suitability for a multitude of conditions and also implemented in therapeutic settings. Due to potential risk of bias in most of the retrieved studies, conclusions have to be taken with caution.

**Implications:** The literature is lacking methodologically sound studies concerning frequency and magnitude of the suggested effects of WATSU, dose-response, or responder-profiles among patients. Therefore, it is proposed that future investigations focus on reassurance of the retrieved information e.g. via qualitative verification by experts, and trials that investigate proposed short- and long-term effects in both, healthy individuals and affected populations.

**Key words:** Mind-body therapies; relaxation; acupressure; complementary therapies

**Funding acknowledgements:** No funding was required to execute this research.

**Ethics approval:** Not required for this kind of study.

## Age-related differences in spinal motion during gait

Schmid Stefan<sup>1,2</sup>, Bruhin Björn<sup>2,3</sup>, Ignasiak Dominika<sup>2</sup>, Romkes Jacqueline<sup>4</sup>, Taylor William R.<sup>2</sup>, Ferguson Stephen J.<sup>2</sup>, Brunner Reinald<sup>4,5</sup>, Lorenzetti Silvio<sup>2</sup>

<sup>1</sup>Bern University of Applied Sciences, Health, Physiotherapy, Switzerland

<sup>2</sup>ETH Zurich, Institute for Biomechanics, Zurich, Switzerland

<sup>3</sup>Swiss Federal Institute of Sports, Magglingen, Switzerland

<sup>4</sup>University of Basel Children's Hospital, Laboratory for Movement Analysis, Basel, Switzerland

<sup>5</sup>University of Basel Children's Hospital, Orthopaedic Department, Basel, Switzerland

**Background:** Although the importance of upper body motion in bipedal gait has been emphasized for several decades, little evidence is available regarding normative data with respect to ageing. In addition, most studies investigating trunk kinematics have not provided adequate quantification of spinal motion, resulting in a limited understanding of the biomechanical behavior of the healthy spine during gait. In order to be able to comprehensively investigate pathologies that directly or indirectly affect the spine, however, accurate knowledge of the biomechanics of a healthy spine during gait with respect to age is critical.

**Purpose:** To assess spinal curvature during gait in healthy adolescents, adults and elderly individuals and to provide a basis for future investigations involving pathologies.

**Methods:** Fourteen adolescents (10-18 years), 13 adults (19-35 years) and 15 elderly subjects ( $\geq 65$  years) were included. Using a previously validated enhanced optical motion capture approach, sagittal and frontal plane spinal curvature angles, general trunk kinematics and spatio-temporal gait parameters were measured during shod walking at a self-selected normal speed. Group differences were investigated using effect sizes and analyses of variance with Tukey HSD post hoc tests. In order to detect the clinical relevance of a kinematic difference, the results were considered in relation to a minimal clinically important difference of  $5^\circ$ . In addition, kinematic parameters were investigated for a possible gait speed dependency using linear regression analyses.

**Results:** Adults presented higher average thoracic kyphosis ( $+10.6^\circ$ ,  $d=1.16$ ,  $p=0.031$ ) and lumbar lordosis ( $+12.6^\circ$ ,  $d=0.88$ ,  $p=0.055$ ) compared to adolescents. Lumbar spine range of motion (ROM) in the frontal plane was smaller in adolescents than in adults ( $-8.4^\circ$ ,  $d=1.84$ ,  $p=0.001$ ) and the elderly ( $-6.3^\circ$ ,  $d=1.26$ ,  $p=0.007$ ), whereby a gait speed dependency was found for the difference between adolescents and elderly ( $R^2=0.169$ ,  $p=0.027$ ) but not for the difference between adolescents and adults ( $R^2=0.027$ ,  $p=0.413$ ). In addition, elderly subjects walked significantly faster than the adolescents ( $+0.09$ ,  $d=2.01$ ,  $p=0.001$ ), but not than the adults.

**Conclusion(s):** Postural differences indicated that lumbar lordosis and thoracic kyphosis increase throughout adolescence and reach their peak in adulthood. The absence of excessive thoracic kyphosis in the elderly could be explained by a previously reported subdivision in those who develop excessive kyphosis and those who maintain their curve. Furthermore, adults displayed increased lumbar spine frontal ROM as compared to the adolescents, whereas the increased values in elderly individuals were found to be related to higher gait speeds.

**Implications:** This dataset provides an insight into the age-dependent kinematics of the healthy spine and can serve as a basis for understanding pathological deviations and monitoring rehabilitation progression.

**Key words:** Upper body; Trunk; Kinematics

**Funding acknowledgements:** 1. Health Division of the Bern University of Applied Sciences; 2. Swiss Physiotherapy Association; 3. AOSpine International (Project CPP FFOB\_OC\_14)

**Ethics approval:** This study was approved by the "Ethikkommission Nordwest- und Zentralschweiz" and the "Ethikkommission der ETH Zürich".

## Is upper limb motion influenced by a structural leg length discrepancy in adolescents during gait?

Schmid Stefan<sup>1,2</sup>, Angelico Fabiola<sup>2</sup>, Freslier Marie<sup>3</sup>, Brunner Reinald<sup>3,4</sup>, Romkes Jacqueline<sup>3</sup>

<sup>1</sup>*Bern University of Applied Sciences, Health, Physiotherapy, Switzerland*

<sup>2</sup>*Zurich University of Applied Sciences, School of Health Professions, Winterthur, Switzerland*

<sup>3</sup>*University of Basel Children's Hospital, Laboratory for Movement Analysis, Basel, Switzerland*

<sup>4</sup>*University of Basel Children's Hospital, Orthopaedic Department, Basel, Switzerland*

**Background:** Structural leg length discrepancy (LLD) is a relatively common problem found in 40-70% of the population. Complications of distinct LLDs (>30 mm) include functional limitations such as gait and balance problems and associated musculoskeletal disorders such as low back pain or stress fractures. Depending on the extent of an LLD, several compensatory mechanisms in the lower extremities and the trunk take place in order to maintain function and to optimize energy consumption during gait. However, studies describing the influence of a structural LLD on upper limb motion are lacking.

**Purpose:** To evaluate upper limb motion in LLD patients compared to healthy controls during gait.

**Methods:** Motion capture data from 14 adolescent patients with structural LLD and 15 age-matched healthy controls that were collected during barefoot walking at a self-selected speed were retrospectively analyzed. In particular, gait speed and kinematic parameters of the shoulder (flexion/extension and abduction/adduction) and elbow joints (flexion/extension) as well as the trunk segment (anterior/posterior tilt, lateral-flexion and axial rotation) were investigated using effect sizes and analyses of variance with Tukey HSD post hoc tests. In order to detect the clinical relevance of a difference, the results were considered in relation to a minimal clinically important difference of 5°.

**Results:** Gait speed in LLD patients was found to be no different from healthy controls. The shoulders in LLD patients on both sides were kept in a more extended position throughout the gait cycle (>+7°, d>1.28, p<0.007) and at initial contact in a more adducted position compared to healthy controls (>+5°, d>0.92, p<0.040). In addition, the patients' elbow joints showed increased flexion motion (>+18°, d>2.11, p<0.001) and the trunk segment indicated a constant trunk lateral-flexion and axial rotation tendency towards the affected side.

**Conclusion(s):** Adolescents with structural LLD indicated clinically relevant compensatory mechanisms in sagittal and frontal plane shoulder motion. These mechanisms were assumed to have occurred for balance recovery after "stepping down" on the shorter leg as well as to align the arm swing in walking direction. Since gait speed showed no differences, a possible speed-dependency of the observed kinematic group differences in the current study can be excluded.

**Implications:** These findings contribute to the understanding of compensatory strategies induced by a structural LLD and might be considered in the planning of physiotherapy treatments and preventive interventions.

**Key words:** Upper body; Arm; LLD

**Funding acknowledgements:** None.

**Ethics approval:** This study was approved by the "Ethikkommission Nordwest- und Zentralschweiz".



## Does an orthotic correction of lower extremity function during gait influence spinal motion in hemiplegic cerebral palsy patients?

(Accepted but withdrawn because of limited number of contribution per presenting author)

Schmid Stefan<sup>1,2</sup>, Romkes Jacqueline<sup>3</sup>, Taylor William R.<sup>2</sup>, Lorenzetti Silvio<sup>2</sup>, Brunner Reinald<sup>3,4</sup>

<sup>1</sup>*Bern University of Applied Sciences, Health, Physiotherapy, Switzerland*

<sup>2</sup>*ETH Zurich, Institute for Biomechanics, Zurich, Switzerland*

<sup>3</sup>*University of Basel Children's Hospital, Laboratory for Movement Analysis, Basel, Switzerland*

<sup>4</sup>*University of Basel Children's Hospital, Orthopaedic Department, Basel, Switzerland*

**Background:** Foot equinus and leg length discrepancy (LLD) are common problems in patients with hemiplegic cerebral palsy (hCP), each causing secondary deviations of pelvic motion during gait. It is therefore plausible that the deviations in spinal kinematics observed in hCP patients occur secondarily as a compensation arising from the disturbed leg function and the associated changes in the position of the pelvis.

**Purpose:** To investigate whether the correction of lower extremity function by orthotics (ankle-foot-orthosis and heel lift) has an effect on spinal gait kinematics in hCP patients.

**Methods:** A total of ten adolescent hCP patients and 15 healthy controls participated in this study. Participants were equipped with 56 reflective markers (combination of Plug-in-Gait full body and IfB marker sets) and measured during barefoot walking at a self-selected speed using a 12-camera motion analysis system (Vicon). Patients then wore shoes with orthotic corrections on the affected side and were measured again. Thoracic and lumbar spinal curvature angles in the sagittal and frontal planes (primary outcomes) as well as segmental trunk, lower extremity joint angles, and spatio-temporal gait parameters (secondary outcomes) were extracted and parameterized accordingly. Comparisons between populations and conditions were conducted using one-way analyses of variance with Tukey post hoc tests and effect sizes. To evaluate the clinical relevance of a difference, a minimal clinically important difference of 5° was used for the angles.

**Results:** The pathological toe-walking gait pattern during the barefoot condition was corrected into a normal heel-to-toe gait pattern when walking with the orthotic corrections. However, this seemed not to influence spinal or general trunk kinematics. Differences could only be found between the hCP patients and the healthy controls.

**Conclusion(s):** Spinal gait deviations in adolescent patients with mild forms of hCP seemed to occur not as a secondary effect of a spastic equinus foot or an LLD but more likely due to proximal abnormalities such as hip flexor contractures, which might have been long-term structural adaptations due to passive secondary effects of foot deformity. The question remains, however, whether lower extremity orthotics in younger patients and/or more severe cases of hCP would have different effects on spinal kinematics. In addition, all patients were used to walking with orthotics and might therefore have already adapted their barefoot walking pattern such that possible effects of orthotics have been diluted. Future research should consider investigating long-term effects of orthotics as well as the relation between spinal kinematics and disease severity.

**Implications:** Considering that the prevalence of chronic low back pain is significantly increased in CP patients and that pain in this population was linked to lower activity levels with a subsequent higher risk for cardiometabolic complications, prevention, especially of low back pain, seems highly indicated. Based on the current results, it can be hypothesized that focusing on an early treatment of lower limb dysfunctions might prevent the development of fixed proximal secondary effects such as hip flexor contractures which could be indirectly responsible for low back pain in a later stage.

**Key words:** Spine; Foot equinus; Ankle-foot-orthosis

**Funding acknowledgements:** The authors acknowledge the Health Division of the Bern University of Applied Sciences and the Swiss Physiotherapy Association (physioswiss) for financial support.

**Ethics approval:** This study was approved by the "Ethikkommission Nordwest- und Zentralschweiz".

## Effects of early clinical assessment of dysphagia on the incidence of aspiration pneumonia in patients undergoing elective pulmonary-resection surgery

Schmidt Leuenberger Joachim M.<sup>1</sup>, Luder Gere<sup>1</sup>, Hokschi Beatrice<sup>2</sup>

<sup>1</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland*

<sup>2</sup>*Inselspital, Bern University Hospital and University of Bern, Division of General Thoracic Surgery, Bern, Switzerland*

**Background:** Aspiration resulting from oropharyngeal dysphagia is a common cause of pneumonia and has been recognized as a serious complication after pulmonary resection. Therefore, it has been recommended that dysphagia be assessed before the initiation of oral intake after surgery. Early detection of dysphagia reduces aspiration pneumonia in hospitalized patients after stroke, but the effect of those assessments has not been proved after elective pulmonary-resection surgery.

**Purpose:** The aim of this randomized controlled trial (RCT) was thus to investigate whether early detection of postoperative dysphagia and subsequent adequate interventions would reduce aspiration pneumonia in patients undergoing elective pulmonary-resection surgery. Secondly, the average hospital length of stay was assessed.

**Methods:** Between February 2014 and May 2016, 438 adult patients undergoing elective pulmonary-resection surgery were randomly assigned to either the intervention group (n = 219) or the control group (n = 219). Standard physiotherapy treatment was administered pre- and postoperatively to all patients in both groups. Patients in the intervention group additionally underwent a clinical assessment of dysphagia before the first oral intake after surgery. For patients with dysphagia, therapeutic interventions were implemented immediately. The primary outcome was the difference in the incidence of pneumonia between the two groups. Statistical analysis included a chi-square test and a t-test. The level of significance was set at  $p < 0.05$  with a power of 80%.

**Results:** Of the total of 492 patients who underwent elective pulmonary-resection surgery during the study period, 438 were included in the intention-to-treat analysis. 33 were operated twice or more but were enrolled only once, while 19 met an exclusion criterion and 2 refused participation. In the intervention group 7 cases (3.2%) with postoperative dysphagia were detected. Pneumonia occurred in 15 cases (6.8 %) in the intervention group and in 27 cases (12.3 %) in the control group. The resulting risk reduction for pneumonia of 5.5% in the intervention group was not statistically significant (95% CI -11.2 to 0.09;  $p = 0.051$ ). Moreover, there was no statistically significant difference of the mean of the hospital length of stay [days] between the intervention group ( $7.7 \pm 6.4$ ) and the control group ( $8.6 \pm 7.1$ ) ( $p = 0.175$ ).

**Conclusions:** Although statistical significance was not given, the physiotherapeutic intervention was effective in every patient with postoperative dysphagia, all of whom did not develop a pneumonia. Hence, there is reason to believe that early detection of dysphagia can prevent pneumonia in patients undergoing elective pulmonary-resection surgery. As a consequence, postoperative policies and protocols might accommodate this result.

**Implications:** The low incidence of just 7 cases with postoperative dysphagia in 219 patients (the number needed to treat = 31 respectively) is indicative of how difficult it is to select suitable patients for this intervention. Moreover, potential risk factors cannot be determined on the basis of 7 cases. Therefore, we recommend a risk stratification with a nurse-administered screening tool such as the one recommended by Perry and Love (2001), with subsequent physiotherapeutic assessment and intervention if the screening is positive.

**Key words:** Prevention, Swallowing screening, Deglutition disorders

**Funding acknowledgements:** Inselspital, Bern University Hospital, Bern, Switzerland

**Ethics approval:** The trial was approved by the Ethics Committee Bern, Switzerland and has been registered in the German Clinical Trials Register.

## Effect of a virtual reality-based training on upper limb function in patients after stroke: a single-blinded randomised controlled multi-centre trial

Schuster-Amft Corina<sup>1,2</sup>, Eng Kynan<sup>3</sup>, Suica Zorica<sup>1</sup>, Thaler Irene<sup>4</sup>, Signer Sandra<sup>5</sup>, Lehmann Isabelle<sup>4</sup>, McCaskey Michael<sup>1</sup>, Schmid Ludwig<sup>6</sup>, Hawkins Miura<sup>3</sup>, Verra Martin L.<sup>4</sup>, Kiper Daniel<sup>3</sup>

<sup>1</sup>Research Department, Reha Rheinfelden, Rheinfelden, Switzerland

<sup>2</sup>Institute for Rehabilitation and Performance Technology, Bern University of Applied Sciences, Technics and Informatics, Switzerland

<sup>3</sup>Institute for Neuroinformatics, University Zurich and ETH Zurich, Switzerland

<sup>4</sup>Department for Physiotherapy, Inselspital, University Hospital Bern, Bern, Switzerland

<sup>5</sup>Physiotherapy Department, Buergerspital Solothurn, Solothurn, Switzerland

<sup>6</sup>Physiotherapy Department, Rehabilitation Centre Clinic Lengg, Zurich, Switzerland

**Relevance:** In recent years virtual reality (VR)-based training has been introduced to neurorehabilitation, with the intention to improve upper limb training options and facilitate motor function recovery.

**Purpose:** The aim of this study was to evaluate an intensive virtual reality training with the YouGrabber system compared to conventional occupational therapy or physiotherapy treatment in a multi-centre setting with three participating centres.

**Methods:** In a prospective, multi-centre, parallel-group randomised controlled trial, patients at least 6 months after stroke onset were allocated to an experimental group (EG, VR training) or to a control group (CG) that receive conventional therapy (16x45 minutes, 4 weeks). Using custom data gloves, patients' finger and arm movements are displayed in real-time on a screen and used to manipulate objects in various virtual environments. The VR-based training focused on a task-related upper-limb treatment in sitting or standing position. In all three centres, blinded assessors tested patients' motor and cognitive performance twice before, once during, and twice after the intervention for hand dexterity (Box and Block Test, BBT) and ADL function using the Chedoke-McMaster Arm and Hand Activity Inventory (CAHAI). The study was registered with ClinicalTrials.gov: NTC01774669.

**Results:** Between January 2013 and December 2015, 70 patients were screened for eligibility, of whom 54 were eligible and agreed to participate (16 female, age 62.5±14, time since stroke 3.1±3years). In total, 22 patients were allocated to EG and 32 to CG including 3 drop outs. Patients in both groups improved over time (baseline to follow-up BBT: 21.2±16 to 24.6±17; CAHAI: 65.6±21 to 70.7±20). No between group differences were found. No severe adverse events related to the study were reported.

**Discussion & conclusions:** Main functional gains occurred in the first two intervention weeks and remained until follow-up. For BBT 5.5 blocks per minute and for CAHAI 6.3 points would have been necessary to determine a meaningful clinical difference. Overall, an average BBT score of 21.2±16 indicates a study population that is severely affected motor functions at entry.

**Impact & implications:** VR and conventional training conducted in one-to-one supervised training with experienced therapists seem to have a similar effect on hand dexterity in chronic stroke patients over a 4-week training period.

**Key words:** Deglutition disorders; Swallowing screening; Prevention

**Funding acknowledgements:** Inselspital, Bern University Hospital, Bern, Switzerland

**Ethics approval:** The trial was approved by the Ethics Committee Bern, Switzerland and has been registered with the German Clinical Trials Register.

## Long-term outcome of knee osteoarthritis after comprehensive rehabilitation – 5 year follow up and risk for total knee arthroplasty

Verra Martin L.<sup>1</sup>, Angst Felix<sup>2</sup>, Benz Thomas<sup>2</sup>, Lehmann Susanne<sup>2</sup>, Winteler Balz<sup>1</sup>, Aeschlimann Andreas<sup>3</sup>

<sup>1</sup>*Inselspital, Bern University Hospital, Department of Physiotherapy, Bern, Switzerland*

<sup>2</sup>*Rehabilitation clinic "RehaClinic", Research, Bad Zurzach, Switzerland*

<sup>3</sup>*Rehabilitation clinic "RehaClinic", Rheumatology, Bad Zurzach, Switzerland*

**Background:** Knee osteoarthritis affects mobility, the most important physical function leading to substantial loss of quality of life. Various treatment options are available to persons with knee osteoarthritis. Physiotherapy and strength training are the most effective conservative therapies with highest evidence. When the conservative treatments fail to relieve pain and improve activity limitation, total knee arthroplasty is usually considered as an effective option.

**Purpose:** To (1) quantify effects on pain, function, and health-related quality of life up to 5 years after a comprehensive rehabilitation program of knee osteoarthritis, and (2) to identify risk factors associated with receiving knee arthroplasty during the observation period.

**Methods:** A prospective cohort study with assessments at admission to the clinic and at 1, 2, 3, 4, and 5 years after discharge was conducted. Participants were 205 persons with knee osteoarthritis (age 65.7±10.3 years). The intervention at the start of the study was a 2-6 week lasting in- or outpatient program consisting of patient education, individual physiotherapy (mainly strengthening), group therapies (mainly endurance training and swimming with flippers), and various passive therapies (massage, fango packs). Changes in health state were measured with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36). For the relative risk of getting knee arthroplasty, odds ratios (OR) were calculated by multivariate logistic regression analysis.

**Results:** Over the 5 year follow up, comprehensive rehabilitation of knee osteoarthritis showed effects sizes (ES) of 0.13 to 0.79 in pain, -0.12 to 0.42 in function and -0.25 to 0.21 in psychosocial health. In this period, 48 persons (23.4%) were referred to knee arthroplasty. Measured at the last time point before knee arthroplasty, worsening on WOMAC pain (ES = -0.42; p = 0.001) and function (ES = 0.54; p = 0.002) predicted the need for knee joint replacement surgery. Female sex (OR = 3.30), higher educational level (OR = 3.54), higher number of comorbidities (OR = 0.71) and WOMAC factor ascending / descending (OR = 1.60) were identified as significant risk factors for knee arthroplasty.

**Conclusion(s):** This study showed that comprehensive in- or outpatient rehabilitation in persons with unilateral knee osteoarthritis may improve pain and physical function during up to 5 year follow up. However, in the course of this degenerative disease about one quarter of the persons (23.4%) were referred for knee arthroplasty: the WOMAC is sensitive to deterioration of pain and function and may predict the need for knee arthroplasty in a subgroup of persons with knee osteoarthritis. Finally, sex female, high educational level, high number of comorbidities and a worsening of the WOMAC factor ascending / descending at the last follow up were identified as significant risk factors for being referred for knee arthroplasty.

**Implications:** The results of this study witness the positive effects of mainly physiotherapy in the long-term conservative management of knee osteoarthritis. Moreover, physiotherapists have access to pragmatic and validated tools to participate in the shared decision process concerning time point of knee arthroplasty.

**Key words:** Knee osteoarthritis; Rehabilitation; Arthroplasty

**Funding acknowledgements:** This study was supported by the Zurzach Rehabilitation Foundation SPA, Bad Zurzach, Switzerland.

**Ethics approval:** This study was approved by the ethics committee of Aarau, canton Aargau, Switzerland (EK AG 2008/026).