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Abstracts 2019

# Masterarbeiten Master of Science in Physiotherapie (MScPT) Studiengang 2016



# Editorial

Sehr geehrte Leserin, sehr geehrter Leser

Bereits zum siebten Mal dürfen wir Ihnen den Abstractband der Masterarbeiten des Studiengangs Master of Science in Physiotherapie (MScPT) präsentieren.

Im Mittelalter stand die Sieben in der christlichen Zahlensymbolik für Gnade, Ruhe und Frieden und stellte die Kombination von Geist und Seele dar. Oft wird die Zahl sieben als Glückszahl angesehen.

Seit 2013, als die ersten Studierenden den MScPT abgeschlossen hatten, entstanden jährlich rund 20 Masterarbeiten. 143 sind es ganz genau. Mehr als die Hälfte davon wurde in internationalen Fachzeitschriften, meist in Englisch, publiziert und noch mehr Arbeiten wurden an nationalen und internationalen Kongressen präsentiert. Am Weltkongress Physiotherapie, der dieses Jahr in Genf stattfand, waren unsere MScPT Absolvierenden eindrücklich zahlreich vertreten mit Präsentationen und Postern. Es macht uns stolz, dass sie mit ihren Master- und weiteren Forschungsarbeiten auf internationalem Niveau mithalten können.

Ein weiterer Beleg für die Relevanz einer Masterarbeit ist, ob diese Inputs für weitere Forschung liefert oder gar den Weg in die klinische Praxis findet und implementiert wird. Hier herrscht grosser Handlungsbedarf, denn Studien belegen, dass 50 % aller Forschungsergebnisse im Gesundheitswesen die klinische Praxis nie erreichen.

Ein grosses Dankeschön an unsere Dozierenden und Betreuenden für die kontinuierliche Unterstützung der Studierenden und des MSc Physiotherapie!  
Den MScPT Absolvierenden gratulieren wir herzlich zu den gelungenen Masterarbeiten und zu ihrem Abschluss!



A handwritten signature in black ink, appearing to read 'K. Niedermann'.

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# The Plagiocephalometry Assessment: A Cross-Sectional Reliability Study of the German Version in Infants and Young Children With Skull Asymmetries

**Purpose:** To determine the test-retest and inter-rater reliability of the categories of severity in cranial deformities measured with the German version of the assessment plagiocephalometry (PCM) in children between one and 24 months with and without plagiocephaly and/or brachycephaly.

**Methods:** Fifty children were measured three times by two raters with the PCM and evaluated individually. Agreement between the categories of severity "normal", "mild", "severe" and "very severe", was quantified with a quadratic weighted kappa ( $\kappa_{qw}$ ).

**Results:** For the severity categories of the plagiocephaly,  $\kappa_{qw}$  values were 0.26 for the test-retest reliability and 0.35 for the inter-rater reliability. In the severity categories of the brachycephaly,  $\kappa_{qw}$  values were 0.56 for the test-retest reliability and 0.63 for the inter-rater reliability.

**Conclusion:** For plagiocephaly, the categories of severity could not be determined with sufficient reliability. For brachycephaly, it was possible to determine the severity sufficiently for inter-rater.

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### International Classification of Functioning, Disability and Health Children and Youth Version Incontinence Assessment Form (ICF-CY-IAF) From the Perspective of Physical Therapists: An International Delphi Survey. There Is More to it Than b525 and b620.

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**Purpose:** The aim of this study was to create an Incontinence Assessment Form of less than 90 categories which can identify the problems and resources of children and youth with urinary and /or faecal incontinence as components of the International Classification of Functioning, Disability and Health (ICF-CY-IAF).

**Methods:** Forty International Physical Therapists experienced in the treatment of children with Incontinence were asked in a sequential mixed method about the problems affected child face and their resources. The survey implemented 3 rounds of mail questionnaire, following the Delphi-Method.

**Results:** 29 physical therapists participated. The consent was found in 50 out of 169 categories by more than 75%.

**Conclusions:** With 50 Categories the ICF-CY-IAF is practicable for praxis and research, for physical therapists and other health professionals. The perception of the physical therapists needs to be complemented by the perspective of other professionals, in multi professional settings.

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## Trunk Muscle Function in Persons With and Without Chronic Nonspecific Low Back Pain: Differences in Muscle Strength, Strength Endurance and Activity and Their Association With Functional Limitations

**Objective:** To evaluate whether muscle function in terms of strength, strength endurance, fatigue and activation differs between sedentary workers with and without chronic nonspecific low back pain (CNLBP) and to determine the association between functional limitations and muscle function parameters.

**Design:** Case control study

**Setting:** This study was conducted by physical therapists and researchers in a laboratory for functional biomechanics at a university hospital.

**Participants:** A volunteer sample of sedentary workers with CNLBP for at least 3 months (n=16) and healthy, age and sex matched controls (n=16).

**Interventions:** Not applicable.

**Main outcome measure:** Trunk muscle function parameters: peak torques normalized to body mass in isokinetic strength test, fatigue (median frequency slope in electromyography) and endurance (test time) in Biering-Sorensen test, muscle activation (cocontraction index (CCI)); disability for CNLBP: Oswestry Disability Index (ODI)

**Result:** The mean differences of the matched pairs between the healthy participants and the participants with CNLBP in trunk extensors was 0.63 Nm\*kg<sup>-1</sup> (95% confidence interval (CI) [-0.49;1.76]) and in trunk flexors 0.38 Nm\*kg<sup>-1</sup> (95% CI [-0.03;0.84]). Difference in CCI was most pronounced on the right side (0.09 (95% CI [0.00;0.20])). These results were inconclusive due to wide CI. Comparable group performance was found in trunk muscle endurance (mean group difference -6.1 s, 95% CI [-41.7;30.8]) and fatigue (mean group difference -0.03 Hz\*s<sup>-1</sup>, 95% CI [-0.12;0.07]), The ODI score was explained to about 22% by the endurance performance.

**Conclusion:** A trend towards reduced trunk muscle strength and asymmetric reduced CCI in CNLBP was observed, but these findings need validation in larger studies. Endurance performance was found to be associated with functional disability.

### Betreuungsperson

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# Exergaming With Promoted Head Turns Facilitates Vestibular Function in Patients With Chronic Peripheral Unilateral Vestibular Hypofunction

**Background:** This study aimed to analyze how exergaming with promoted head turns and unsupported locomotion may facilitate vestibular functions and gait in the patients with chronic peripheral unilateral vestibular hypofunction (CPUVH). The study is registered under ClinicalTrials.gov NCT03536533.

**Methods:** Nine patients (mean age of  $64.56 \pm 13.42$  years, 6 males and 3 females) participated in a total of 152 min of exergaming including different physical parts in eight sessions. There were three-measurement sessions at a one-month interval: one month before baseline (t0), baseline (t1), and after the intervention (t2). The primary outcome was dynamic visual acuity (DVA); the secondary outcomes were functional gait assessment (FGA), extended timed get-up-and-go (ETGUG), dizziness handicap inventory (DHI), and game scores. To test pre-post differences, t-test, Wilcoxon test, and Cohen's d for effect size were performed.

**Results:** After exergaming, dynamic visual acuity showed a small effect size ( $r=.21$ ) and no significant difference between VA-Loss at baseline and post intervention ( $p=.558$ ,  $t=-.612$ ,  $n=9$ ). There was a significantly higher total score in FGA ( $p=.002$ ) and a strong effect size ( $r=.89$ ). In ETGUG, a significant improvement ( $p=.027$ ) and a strong effect size ( $r=.73$ ) were observed. Finally, the results for DHI were  $z=-.535$ ,  $p=.672$ ,  $n=9$ , and the effect size was small ( $r=.18$ ).

**Discussion and Conclusion:** The results of this case-crossover study demonstrate that exergaming with promoted head turns facilitates vestibular function in the CPUVH patients. The function of gait showed a particularly strong improvement. However, not all patients improved in terms of DVA, which could be attributed to the different medication intake, as well as insufficient training intensity and duration. In further research, these factors should be considered, and a more specific test cluster to measure vestibular functions in the CPUVH patients should be performed.

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# The Effect of the Multidirectional Un- stable Shoulder on Functional Strength Development

**Introduction:** Subjects with a multidirectional unstable shoulder (MDI) have significantly altered muscle activation and different movement patterns in elevation. This leads to scapula dyskinesia, where the scapula is the link for the force transmission of the kinetic chain (KC). The incidence of MDI is unknown.

**Assumption:** MDI causes an interruption of the KC, which leads to a loss of performance in the periphery.

**Method:** For this pilot study five volunteers meeting clear inclusion criteria were recruited and measured according to a standardised protocol in the isometric leg force with and without tape. The measured directions were knee extension, knee flexion, plantar flexion and dorsal extension.

**Results:** Plantar flexion of the left foot was the only direction that showed more maximum force with external tape stabilisation for all five subjects. With tape application, left-sided plantar flexion becomes stronger, while all other directions with tape application become stronger on the right side.

**Discussion:** Evidence from this study shows that the stabilisation of the multidirectional unstable shoulder has an influence on the lower body and enhances in particular the functional development of the force in the periphery. These results could help to identify an unstable shoulder in combination with a local examination.

## The Effect of Finding-Oriented Mobilization in Adults With Chronic Ankle Instabilities (CAI) on the Muscular Activation and the Dynamic Balance. A Randomized Prospective Feasibility and Pilot Study

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**Background:** A twist of the ankle happens very quickly and follows in up to 34% of the cases in a chronicity. Previous studies analyzed effects of manual therapy on chronic ankle instability (CAI), but none considered a finding-oriented approach. Nowadays this is how we treat patients, and therefore the urge is there to test this way of treatment on CAI. The purpose of this study is to show the feasibility of this pilot study on a larger scale. Additionally, it highlights the effect of nine finding-oriented mobilizations in adults with CAI on muscular activity and dynamic balance.

**Methods:** In this crossover trial, nine participants; two men, seven women, mean age 26 ( $\pm$  6) years were randomly distributed into two groups. The feasibility was analyzed through four success criteria; adherence and attrition rates, safety and acceptability. For secondary outcomes, the muscular activity was measured by surface Electromyography (sEMG) as for the dynamic balance, the Time to Stabilization (TTS) and the modified Star Excursion Balance Test (mSEBT) were used.

**Results:** As primary criteria, success criteria showed a high adherence (90%) and attrition rate (10%). Adverse events happened only for two participants. The acceptability reached 6.47 out of nine points, mainly because of the large time required for recruitment, measurements and interventions. Secondary outcomes showed divergent results in all three tests with only a few statistically significant p-values.

**Conclusion:** Measurements on a larger scale can be carried out under condition of a strict crossover design and an adequate warm-up.

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# Age Effect on Pressure Pain Threshold of Asymptomatic Ankles and Knees in Young Individuals With and Without Haemophilia: a Cross-Sectional Study

**Introduction:** Despite adequate medical treatment, many young adults with haemophilia develop joint alterations – especially in ankles and knees. Undetected over years, subtle structural changes cause subclinical symptoms, before problems become obvious. To objectify these silent periarticular pressure pains, also referred to as silent symptoms, the pressure pain threshold (PPT) can be measured by algometry.

**Aim:** The aim was to investigate and compare the age effect on PPTs in asymptomatic ankles and knees between boys and young adults with haemophilia and age-matched controls in order to gain better knowledge about the alteration of the periarticular structures with increasing age.

**Material and methods:** Nineteen persons with haemophilia (PwH; severe or moderate; 8-30 years) and 19 age-matched controls with 'healthy' ankles and knees were recruited. Asymptomatic joints with a Haemophilia Joint Health Score = 0 were included. The PPT was measured on four periarticular points per joint, and the data was analysed with a linear mixed model.

**Results:** The PPT of the control group increased with age, whereas the PPT of the PwH decreased. The difference in age effect per year in kPa between PwH and controls was: [95%-CI]: - 15.41 [-31.63; 0.79]. Even though the result was not statistically significant ( $p = .08$ ), a clear tendency was shown.

**Conclusion:** With growing age, the PPT of ankles and knees of PwH decreases even in asymptomatic joints. Simultaneously, the gap to the PPT of healthy controls increases. This suggests that subclinical alterations in the periarticular structures of these joints develop unnoticed over time.

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## Quantifying Lower Extremity Joint Angles Using the myon® aktos-t System: a Reliability and Method Comparison Study

This study aimed at the investigation of intra-session and inter-session reliability of the inertial measurement unit system (IMU) myon® aktos-t and the comparison to a gold standard system during the activities walking, running and counter movement jump (CMJ). Twenty healthy young adults were participating in two identical repeated assessments on the same day and 7-10 days apart. Sagittal plane hip, knee and ankle angles were extracted as discrete range of motion (ROM) parameters and as continuous values over a full movement cycle. Reliability was evaluated according to a three-step approach. For continuous values, t-tests were conducted using one-dimensional Statistical Parametric Mapping. Systems were compared using Bland-Altman analyses and t-tests. Relative reliability was fair to excellent for intra- and inter-session. Minimal detectable changes (MDC) ranged from 3.3° to 24°. For continuous intra-session data, ICCs were 0.55 and MDCs ranged between 3° and 40. Inter-session reliability ranged from very low (ICCs 0.20 for hip and knee angles during walking and running) to high (ICC 0.80 for knee and ankle in CMJ), with MDCs of 3-45°. For ROM, the systems strongly agreed for hip and ankle angles, but not knee angles. The evaluation of continuous data revealed general overestimation of hip and knee and underestimation of ankle angles by the IMU system. Considering a few limitations such as the low reliability for knee joint ROM as well as the partially very low inter-session reliability for continuous hip and knee angles, our findings indicate that the myon® aktos-t system can be used for the quantification of lower extremity joint angles during functional activities.

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# The Effect of Gluteal Muscle Activation During Running in Rocker Shoes.

**Objectives:** Iliotibial syndrome (ITBS) is one of the most common types of running injuries. Several previous studies have focused on the association between ITBS and hip muscles forces as the same is often the target of rehabilitation interventions. These studies reveal a possible effect of a curved outer sole on the mechanics of the lower-limb during running. The Scott Sports company has developed such a running shoe, called the “eRide rocker shoe”. The purpose of this study is to assess the effect of different rocker shoes and running activities on muscular activation of the musculus gluteus medius (GMed) and maximus (GMax).

**Design:** This is an observational, cross-sectional, monocentric study.

**Methods:** Fifteen experienced male runners were asked to run on the laboratory floor and treadmill, running on level, uphill, and downhill grades, with three different curved rocker shoes. Surface electromyography data were collected for the GMed und GMax. A linear mixed model was fitted to the data. Reliability was investigated by generalizability theory and intraclass correlation coefficient (ICC) calculations for each condition.

**Results:** The linear mixed models revealed no interaction effects. Significantly greater muscle activation of the GMed was observed in comparison to the GMax, both in duration and peak activation ( $p=0.0214, p=0.0409$ ). During uphill running, significant decreases were observed in both peak ( $p=0.0212, \log \%MVC$ ) and duration ( $p=0.0148, \log \%MVC$ ) as compared to overground. Augmented shoe curve increased average and peak muscle activation.

**Conclusions:** In conclusion, rocker shoes have a proven effect on gluteal muscle activation and might benefit runners with an increased risk for RRI.

### Betreuungsperson

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# Beneficial Effects of Combined Aerobic Exercise and Cognitive Training on Cognitive Function in Patients With Cognitive Impairment – a Systematic Review and Meta-Analysis

**Background:** Prevalence of cognitive impairment (CI) increases as world population ages. Evidence shows positive effects of aerobic exercise (AE) or cognitive training (CT) on cognitive function (CF) in patients with CI. It was hypothesized, that combining AE and CT is more effective to improve CF in patients with CI than single training strategies (AE or CT alone).

**Objective:** The aim of this systematic review and meta-analysis was to evaluate if the efficacy of a combined therapy (AE+CT) is higher as compared to AE or CT alone to improve CF in patients with CI.

**Methods:** Pubmed, Embase(OVID) and SPORTDiscus were searched. Risk of bias assessment of individual studies was conducted. Data synthesis was generated using standard mean differences (SMD) and random effects models. Heterogeneity testing and subgroup analyses were conducted.

**Results:** A total of eight studies were included in the meta-analysis. Efficacy of (AE+CT) was higher as compared to AE or CT alone on executive function (SMD= 0.228, [95%CI= -0.116 to 0.572]), attention (SMD= 0.131, [95%CI= -0.267 to 0.529]) and memory (SMD= 0.183, [95%CI= -0.149 to 0.516]). Subgroup analyses suggested an effect of AE+CT versus CT on executive function (SMD= 0.716, [95%CI= 0.105 to 1.327]) and attention (SMD= 0.494, [95%CI= -0.046 to 1.034]) but not in AE+CT versus AE on executive function (SMD= -0.041, [95%CI= -0.386 to 0.304]) and attention (SMD= -0.176, [95%CI= -0.540 to 0.188]).

**Conclusion:** Based on this set of studies, there is but very weak evidence that a combined (AE+CT) intervention is beneficial as compared to single intervention (AE or CT alone) on cognitive function in patients with CI. Further high quality and well powered RCTs investigating such combined interventions are necessary in patients with CI.

**Keywords:** cognitive impairment, combined aerobic-cognitive training, beneficial effects, aerobic, cognitive training, cognitive function

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# Reliability and Validity of the German Translation of the Pediatric Balance Scale in Children With Neuromotor Deficits

**Aim:** This study investigated the inter-rater and test-retest reliability as well as the convergent and discriminative validity of the German version of the Pediatric Balance Scale (PBS) in patients with neuromotor disorders.

**Method:** Thirty participants with neuromotor disorders (13 females; mean age 9.6 years, SD 3.8) undergoing physiotherapy, were included. They performed the PBS twice; Trunk Control Measurement Scale (TCMS) and Gross Motor Function Measure (GMFM) once, while their parents filled in the Functional Mobility Scale (FMS). Intraclass correlation coefficient (ICC) and smallest detectable change (SDC) were calculated for the reliability. Spearman correlation coefficients and receiver operating characteristics were used to evaluate the validity.

**Results:** All participants scored high on the PBS. The reliability was very high (ICC inter-rater= 0.97, ICC test-retest= 0.96). Score changes in the PBS of at least 2 points can be considered as true change. Correlation coefficient between PBS and TCMS, GMFM and FMS ranged from 0.61 to 0.85. PBS can discriminate best with combined sensitivity (0.77) and specificity (0.85) between participants walking independently on every surface and those needing support.

**Interpretation:** The PBS is a valid and reliable assessment for patients with neuromotor deficits, but certain adaptations might improve the sensitivity to detect balance impairments.

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# Use of an Inertial Sensor System to Detect Differences in Gait Pattern: A Comparison Between Individuals With Severe Gonarthrosis and Asymptomatic Individuals

**Background:** While walking, kinematic differences between the affected and nonaffected leg are already present in early stages of gonarthrosis. To date, studies and data focusing on the surrounding joints are scarce. As existing findings already point out the link between the occurrence of hip and knee osteoarthritis, it is of importance to also focus on hip and ankle data in gonarthrosis patients.

**Purpose:** The aim of this study was to investigate differences in gait parameters between individuals with severe gonarthrosis and asymptomatic age-matched individuals by testing the dynamic range of motion (ROM) of sagittal hip, knee and ankle angles when using RehaGait®.

**Methods:** 12 individuals with severe gonarthrosis and 33 age-matched asymptomatic individuals were enrolled in this study. Spatiotemporal and sagittal kinematic gait parameters were recorded with the inertial sensor system RehaGait® during walking a distance of 20 meters. Data analysis included multiple within-group and between-group comparisons using t-tests. All results could be shown with the RehaGait® system.

**Results:** On the affected side of the knee arthrosis, a significantly different dynamic ROM between the groups was detected in the ankle joint. There were also clear tendencies in reduced dynamic flexion of the knee joint, with no dynamic angle differences being found in between-group-comparison in the hip. The within-patient-group side comparison showed a significantly reduced flexion in the affected knee compared to the nonaffected knee.

**Conclusion:** The results showed that there are differences between gonarthrosis patients and asymptomatic individuals not only with regard to the knee joint, but also in the surrounding joints. These findings lead to the assumption that different types of compensation mechanisms occur in gonarthrosis patients while walking. In order to better understand this complex interaction, further research is needed. The identification of potential evasive movements in surrounding joints, could provide information for early treatment of the entire lower limb in order to prevent consequential damage.

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# Literature Review to Evaluate the Effectiveness of Trigger Finger Interventions

The aim of this review was to evaluate Trigger finger interventions based not only on statistical significance but also on clinical relevance.

Two different statistical methods were used for data analysis. For the analysis of all study designs, the weighted mean method was used and then compared with the MIC from the literature. The method of raw mean difference with continuous data was used in the meta-analysis. These data were then compared with the MID.

Only the comparison of subcutaneous surgery and steroids in NRS after 3 months showed significant differences in the subcutaneous surgery group. However, the MIC was not reached. In short-term follow-up, steroid injections showed good results, while subcutaneous surgery dominated long-term follow-up. None of the analyses showed a clear statistical difference and fulfilled the MIC from the literature. These findings seem to generate a standardized data analysis to compare different study designs.

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# Applicability of a Novel Tactile Acuity Training Device in Patients With Non-Specific Chronic Low Back Pain

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**Purpose:** Tactile acuity is decreased in patients with non-specific chronic low back pain (NSCLBP) resulting in an increased two-point discrimination (TPD) threshold. The objective of this study was to determine the applicability of a novel tactile acuity training device (TacTile) in patients with NSCLBP.

**Materials and Methods:** Six participants with NSCLBP performed home-based training with the TacTile for three consecutive weeks, two times a day. Assessing the usability was conducted with the System Usability Scale (SUS) and a semi-structured interview. The acceptability was evaluated by adherence and the interview, the functional clinical changes were assessed with the Numeric Rating Scale (NRS), the Oswestry Disability Index (ODI) and the interview. To analyse the changes of the TPD threshold, the files from the TacTile were used.

**Results:** The median SUS score was 71.25, adherence being in the median at 85.7% of all possible training sessions. A minimal clinically important reduction was observed in two participants for NRS and the ODI was lower and higher in three participants each. The TPD was not capable of demonstrating any difference. The qualitative content analysis of the semi-structured interview lead to five main categories: stimulus, design, application, training and changes experienced.

**Conclusion:** Potential improvement of the TacTile consists for the stimulus as sometimes it failed or was less intense. In general, the TacTile was assessed as usable and well accepted by the participants. No major barriers were recorded. It seems to be a helpful device to train the sensory perception of the lower back at home.

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# Effect of Three Different Stability Boots on Ankle Joint Kinetics and Kinematics and Possible Consequences for Patients With Achilles Tendon Ruptures – A Cross Sectional Study

**Background:** Functional rehabilitation with stability boots has been shown to be superior to cast immobilisation after Achilles tendon rupture (ATR). To date, it is unclear how much mobility and tendon loading such boots allow.

The purpose of this study was to evaluate differences in ankle kinematics and kinetics of three different boots.

**Method:** 10 healthy participants were recruited for 3D-motion analysis. Three different boots were analysed at neutral and maximum plantar flexion (max PF) position. ANOVA for repeated measures was calculated.

**Results:** Peak ankle dorsiflexion angles (paDF) and dorsiflexion range of motion (dROM) differ significantly between shoes ( $p < 0.001$ ). Vario Stabil showed the highest paDF and dROM, whereas VACOped showed lowest values. The internal plantar flexion moment is lower in max PF but differs significantly between shoes ( $p > 0.001$ ).

**Conclusion:** The tested stability boots differ significantly. Further research is needed how this influences outcome in ATR rehabilitation.

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# Assessments zur Erhebung des Fitnesszustandes in den Therapiegruppen der Schweizerischen Vereinigung Morbus Bechterew – Eine Machbarkeitsstudie

**Hintergrund:** Die axiale Spondylarthropathie ist eine chronisch-entzündliche rheumatische Erkrankung die zu strukturellen und funktionellen Beeinträchtigungen bei Aktivitäten des täglichen Lebens und beim Sport führen kann. Die Schweizerische Vereinigung Morbus Bechterew bietet betroffenen Personen ein wöchentliches Training in Therapiegruppen an. Unter Anleitung von Physiotherapeuten wird gezielt trainiert um Faktoren wie das kardiorespiratorische Training, die Kraft, die Beweglichkeit und die Neuromotorik zu erhalten bzw. zu verbessern.

**Ziel:** Diese Studie untersuchte die Machbarkeit (Akzeptanz, Praktikabilität und Integration) von Assessments innerhalb einer Therapiegruppe in den vier Fitnessdimensionen kardiorespiratorisches Training (Chester Step Test), Kraft (modifizierter Rumpfkrafttest), Beweglichkeit (Bath Ankylosing Spondylitis Metrology Index) und Neuromotorik (Einbeinstandtest).

**Methode:** Die Assessments wurden einmalig durchgeführt. Mittels ordinalskalierten Fragebogen wurde die Akzeptanz, die Praktikabilität und die Integration der vier Assessments durch Patienten und Therapeuten bewertet. Danach wurden die Assessments nach drei Kriterien Levels eingeteilt.

**Ergebnisse:** Die beiden Assessments Chester Step Test und Bath Ankylosing Spondylitis Metrology Index erreichten mit 84% und 87% positiven Antworten das Kriterium Level I. Die beiden Assessments mod. Rumpfkrafttest mit 71% und der Einbeinstandtest mit 76% positiven Antworten erzielten Kriterium Level II.

**Schlussfolgerung:** Die Studienteilnehmenden zeigten grosse Akzeptanz und die Assessments können in die Therapiegruppen implementiert werden. Die Assessments sind eine wertvolle Ergänzung zur Planung der Therapiegruppe und zur individuellen Therapieplanung, und können als Verlaufszeichen eingesetzt werden.

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# Risk of Falls for People With Parkinson's Disease and the Role of Deep Brain Stimulation

Falls are common for people with Parkinson's Disease and severely impact their quality of life. Postural impairments often do not respond to levodopa and may further deteriorate with Deep Brain Stimulation (DBS). This study investigated the risk of falling for people with Parkinson's Disease before and after Deep Brain Stimulation of the subthalamic nucleus (STN-DBS).

People with Parkinson's Disease treated at the University Hospital of Bern and qualifying for STN-DBS surgery were included in this study. Their risk of falling was measured with a performance based (Mini-BESTest) and a self-reported outcome measurement (ABC scale). They were assessed preoperatively, postoperatively and one year after the operation. Spearman correlations between the two assessments were performed in order to determine their relationship.

Forty-three people with Parkinson's Disease met the inclusion criteria for the study. The median Mini-BESTest score preoperatively was 21/28. After the operation the median score was 20/28. One year later, the median score was 23/28. The median ABC scale scores were 78/100 preoperatively, 83/100 postoperatively and 81/100 one year after operation. There was no significant change in the risk of falling between the three measurement time points. At baseline and at the one-year assessment, the two measurements showed a fair correlation ( $r = 0.47$ ,  $p = 0.49$ ) and a moderate correlation ( $r = 0.58$ ) postoperatively.

There was no statistically significant change in the risk of falling nor of the fear of falling after STN-DBS in this population. With the operation, seven out of 43 (16%) people with Parkinson's Disease changed in their risk of falling measured with the Mini-BESTest and 11 of 41 (27%) measured with the ABC scale. Increased prevalence of falls after DBS might be explained by a higher exposure to risk due to better mobility. People with Parkinson's Disease might find themselves in new and unknown situations due to faster movement and changed biomechanics as a result of reduced rigidity and bradykinesia.

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# Effect of Brain-Computer Interface Technology Based on Non-Invasive Electroencephalography (EEG) Using Motor Imagery on Functional Recovery After Stroke – A Systematic Review and Meta-Analysis

**Background:** Brain-computer interface technology for rehabilitation of patients after stroke is rapidly developing. BCI technology allows multiple intervention modalities in patients with different levels of impairment.

**Objective:** The aim of this study was to summarize the evidence from selected studies evaluating recovery. In addition, robustness of the observed effect-size and different covariates such as level of impairment, training duration and the interaction between both were evaluated.

**Methods:** A systematic literature search was performed in Medline, IEEE Xplore Digital Library, Cochrane database, and Embase in July 2018, and was repeated in March 2019. Randomized controlled trials or controlled clinical trials that included BCI technology for improving motor and brain recovery in stroke survivors were identified. Articles were reviewed and “risk of bias” was evaluated with the ROB2.0 Tool, while for risk of bias across studies, the GRADE approach was used. Results were analyzed using the random-effects model. Meta-regression was used to observe covariates.

**Results:** After removing duplicates, a total of 665 articles were identified. Fourteen trials met the inclusion criteria.

Quantitative analysis showed that in patients after stroke, BCI technology training compared to conventional therapy alone was associated with a standardized mean difference (SMD) of 0.39 [95%CI: 0.17 to 0.62] and corresponding 95% prediction interval of 0.13 to 0.66 for motor function recovery of the upper extremity, while an SMD of 0.41 [95%CI: -0.29 to 1.12] for motor function recovery of the lower extremity was found. The effect-size of BCI technology on brain recovery was an SMD of 1.04 [95%CI: 0.64 to 1.45], with a 95% prediction interval ranging from 0.37 to 1.71. Covariates such as duration of training, level of impairment of upper extremity, and the combination of both did not show significant effects in meta-regression.

**Discussion:** This meta-analysis showed evidence that BCI technology may enhance motor functioning of the upper extremity and brain function recovery. However, evidence for a positive effect of BCI technology on motor functioning of the lower extremity in patients after stroke remains poor. Assessments to judge the quality of the applied motor imagery were lacking in the included studies. Future studies should include long-term follow-ups.

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# Patellar Tendon Shortening for Flexed Knee Gait in Bilateral Spastic Cerebral Palsy – A Retrospective Mid- and Long-Term Follow-up

**Background:** Flexed knee gait is a common gait dysfunction in individuals with bilateral spastic cerebral palsy (BSCP) and is often addressed with single event multilevel surgery (SELMs). However, long-term observations are rare, and results are reported in discrete parameters or summary statistics where temporal aspects are not considered.

**Research question:** Does the improved knee joint kinematics after patellar tendon shortening (PTS) as part of SELMs persist for 7 years after surgery in individuals with BSCP?

**Methods:** Data of instrumented gait analysis of twelve participants (females/males: 5/7, mean age: 15.3 ± 3.4 years) with BSCP treated with PTS as part of SELMs were retrospectively analyzed. Participants had had follow-up gait analysis approximately 5 and 7 years or more after surgery. Three-dimensional lower extremity kinematics of walking at a self-selected speed were collected using a 12-camera motion capture system and 4 embedded force plates. One-dimensional statistical parametric mapping (SPM) was used for data analysis, permitting group comparisons of continuous data instead of predefined discrete parameters.

**Results:** Previously demonstrated short-term improvements of sagittal knee joint kinematics can be maintained up to 7 years after surgery. Normalized walking speed does not deteriorate over the observation period.

**Significance:** Positive effects of PTS as part of SELMs persist up to 7 years after surgery and progressiveness of flexed knee gait can be reduced. Thus, if the clinical examination indicates an operation, improved kinematics can be achieved for the longterm.

**Keywords:** Cerebral palsy, Flexed knee gait, Single event multilevel surgery, Gait kinematics, Long-term follow-up

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# Assessment of Diaphragmatic Weakness in Children With Neuromuscular Diseases. A Pilot Study of Sniff Nasal Inspiratory Pressure Measurements.

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**Background:** Pulmonary function testing in sitting and supine position is of particular importance to detect diaphragmatic weakness. It is usually assessed by measuring spirometry. These tests have limitations in young children and those with cognitive or bulbar impairment. Sniff nasal inspiratory pressure (SNIP) has been shown to be easy to perform and a reliable test of inspiratory muscle strength.

**Aim:** The aim of this study was to assess whether SNIP, measured in sitting and supine position, is associated with spirometry in children with NMD.

**Methods:** Fourteen children diagnosed with neuromuscular disease underwent the assessments of SNIP and Forced Vital Capacity (FVC) during one single session. All maneuvers were performed in sitting and supine position. Differences (SNIP, FVC) and relative changes (% SNIP, % FVC) between sitting and supine position were calculated. Wilcoxon test and Spearman's rank correlation test were applied.

**Results:** SNIP was positively correlated with FVC in sitting ( $r = 0.605$ ,  $p = 0.022$ ) as well as in supine position ( $r = 0.625$ ,  $p = 0.017$ ). There was a positive correlation between SNIP and FVC ( $r = 0.688$ ,  $p = 0.007$ ) and a negative correlation between % SNIP and % FVC ( $r = -0.789$ ,  $p = 0.001$ ).

**Conclusion:** The findings of this study indicate that measurements of SNIP in sitting and supine position present a possible alternative method to assess diaphragmatic weakness in children with NMD. Further studies are needed to determine the most appropriate cut-off value detecting diaphragmatic weakness by SNIP.

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# Advanced Physiotherapy Practice – Perspektiven von Stakeholdern im Gesundheitswesen in der Deutschschweiz

**Hintergrund / Ziel:** Die demographische Entwicklung und ein zu erwartender Fachkräftemangel erfordern eine adäquate Anpassung der Gesundheitsversorgung und neue Aufgabenverteilungen in den Gesundheitsberufen. Advanced Physiotherapy Practice (APP) Modelle können die Versorgungsqualität verbessern und berufliche Perspektiven in der Physiotherapie aufzeigen. Im Teilprojekt der ZHAW der schweizweiten Initiative gegen den Fachkräftemangel werden deshalb APP-Modelle für die Schweiz entwickelt. Ziel dieser Arbeit ist es Erfahrungen, Visionen und Vorstellungen von Stakeholder im Gesundheitswesen aus der Deutschschweiz zu APP in der Schweiz aufzuzeigen.

**Methode:** Zehn Stakeholder aus verschiedenen Bereichen des Gesundheitswesens wurden mittels Experteninterviews zu APP befragt. Die Interviews erfolgten im Zeitraum von August 2018 bis April 2019. Anhand individuell entwickelter semistrukturierter Leitfäden wurden die Bereiche Fachkräftemangel, Definition, Tätigkeitsbereiche, Bildungshintergrund und von APP, deren Chancen und Gesetzliche Grundlagen abgefragt. Die Transkripte wurden mittels qualitativer Inhaltsanalyse nach Mayring analysiert. Die deduktiv und induktiv durchgeführten Kodierungen wurden in einem Kodierleitfaden zusammengestellt.

**Resultate:** Nach Aussagen der befragten Stakeholder sollen APP-Rollen in hochkomplexen Patientensituationen verschiedener Fachbereiche eingesetzt werden, um eine engere interprofessionelle Zusammenarbeit zu fördern, die Versorgungsqualität des Patienten zu verbessern und die Berufsattraktivität der Physiotherapie zu steigern. Kernkompetenzen sollen in leitende Funktionen und klinische Tätigkeiten im stationären und ambulanten Setting eingesetzt werden. Ein Masterabschluss und mindestens fünf Jahre Berufserfahrung werden als Voraussetzung betrachtet. Gesetzlich gilt es im Anordnungs- und Delegationsmodell einzig Arztvorbehaltene Tätigkeiten einzuhalten. Für das Berufsprofil Physiotherapie werden neue Karrieremöglichkeiten aufgezeigt, welche einen positiven Einfluss auf die Berufsverweildauer haben können.

**Diskussion / Schlussfolgerung:** Ein umfassender Überblick über die Erwartungen, Visionen und Vorstellungen von Stakeholdern zu APP in der Schweiz konnte aufgezeigt werden. Die befragten Stakeholder haben klare Visionen und Vorstellungen zu APP. Zukünftig müssen weitere Stakeholder zu APP befragt und erste Pilotprojekte mit einzelnen APP-Rollen durchgeführt werden. Diese Erkenntnisse dienen der weiteren Entwicklung von APP-Modellen.

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# The Cost-of-Illness in Patients With Chronic Stroke Related Disorders Living in the Larger Area Around Basel (Switzerland)

**Aim/Background:** The economic burden of care for stroke is high internationally and Switzerland is no exception. In 2010, the Swiss prevalence of stroke cases was 71,000, resulting in a total cost of 734 million € from a healthcare perspective. The cost-of-illness of one stroke patient was 10,303 € and the costs increase in relation to the disability level. The quality of life in patients with stroke-related disorders was influenced by the prevalence of comorbidities and the level of disability. The purpose of this study was to investigate direct (medical and non-medical) and indirect healthcare costs, comorbidities, level of disability and quality of life in the chronic stroke population of the Basel region.

**Methods:** The research team recruited 21 chronic patients with stroke-related disorders among patients visiting the REHAB Basel clinic and three physiotherapy private practices. This cost-of-illness study had a societal perspective (3-months time frame). It estimated the costs and the prevalence of comorbidities using self-reported questionnaires. The modified Ranking Scale assessed the disability level. The European Quality-of-Life-5D questionnaire delineated the health state and the corresponding health utility index for participants.

**Results:** The average total health costs of 25,360 CHF (Standard Deviation 14,012 CHF) for three months, observed in this sample, were higher than the health costs in the general Swiss population and other chronic pathologies. Patients with stroke-related disorders caused high societal costs, mainly driven by indirect costs, such as productivity loss (46%) and informal care (5%) besides the important direct medical costs, like hospitalisation (9%) and medications (7%). Participants presented cardiovascular (43%), metabolic (52%) and mental (76%) comorbidities, with an average consumption of six drugs per day per person. Health utilities were similar to those presented in the literature and lower than the general Swiss population.

**Conclusion:** The cost-of-illness of patients with stroke-related disorders is higher than other pathologies, as multiple sclerosis and rheumatoid arthritis. Strategies to enhance secondary and tertiary prevention and social integration in the Basel area should be investigated. A further implementation of guidelines for long-term care in patients with stroke-related disorders might be suggested.

**Keywords:** Cost of Illness, Stroke, Neurological Physiotherapy, Public Health

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## The Effect of Selective Dorsal Rhizotomy on Gait Kinematics in Children With Cerebral Palsy

**Background:** Selective dorsal rhizotomy (SDR) is an operation performed on patients with the spastic bilateral type of cerebral palsy (CP). The operation is considered to be the only permanent method to reduce spasticity, improve gait parameters and avoid various secondary health issues. However, literature on SDR outcomes is conflicting. The goal of this study was to analyse gait parameters in Estonian children prior to and one year after SDR, compare the outcomes to existing scientific literature and determine whether the received therapies or age affected the outcomes. All SDR operations on Estonian children with CP were performed by the same surgeon in Germany using the single-level method.

**Methods:** A retrospective study was conducted among eight children with the mean age of 11.25 years (range 5 – 17 years). The children had spastic bilateral cerebral palsy (CP) and underwent a gait analysis prior to and one year after SDR. Data was collected with Vicon motion and gait analysis systems (8 MX T-Series infrared cameras, 2 video cameras and 2 AMTI force plates; all solutions were supported by Vicon software: Vicon Nexus and Vicon Polygon). For the analysis, various comparable tables were compiled in Excel, Pearson correlation was used to determine statistical significance and scatter plots to assess relationships between variables.

**Results:** The Pearson analysis indicated a statistically significant correlation between dorsal flexion of the left ankle and age at a 95% confidence interval (sig 0.013 < 0.05). The direction of the relationship was negative ( $r=-0.820$ ). According to the scatter plots, age had a negative relationship with dorsal flexion of the right ankle, knee extension during stance phase and flexion of the left knee during the swing phase. The amount of physiotherapy received had a positive correlation with hip flexion during stance.

**Conclusion:** The effect of SDR on gait kinematics and the influence of Physiotherapy needs further research. Younger patients had better outcomes. The amount of received physiotherapy had small to no positive influence on the improvement of gait. Due to a small sample size, results should be interpreted with caution.

**Keywords:** Selective dorsal rhizotomy; 3D Gait Analysis; cerebral palsy; children

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# Visual Gait Analysis of Stroke Survivors by Physiotherapists: What Can We Really See? A Cross-Sectional Study Evaluating Reliability, Minimal Detectable Change, and Validity

**Introduction:** Cerebrovascular disease is the most frequent cause of disability in adults in Switzerland. As walking disability reduces social participation and quality of life, stroke survivors consider gait recovery as one of the main targets in neurological rehabilitation. Since physiotherapists need to identify and measure gait impairments to develop treatment plans, visual gait analysis (VGA) is a key component of clinical decision-making. According to evidence-based practice (EBP), measurement instruments need to be reliable, valid and sensitive to change. The objective of this study was to assess reliability and validity of five clinically relevant gait parameters measured by VGA, with and without the use of a smartphone application, compared to the 3D Vicon analysis (gold standard), and finally to measure their degree of association with gait speed.

**Method:** A cross-sectional design was used to analyse reliability and concurrent criterion validity of VGA. Subjects underwent a 3D gait analysis at the Children's University Hospital Basel. Two physiotherapists independently estimated the gait parameters using VGA and smartphone application. Reliability was computed using intraclass correlation coefficients and standard error of measurements, from which minimal detectable changes were derived. Validity was assessed using Bland and Altman 95% limits of agreement. For the non-parametric analysis, weighted Cohens' Kappas were used. The relationship with gait speed was explored using Pearson's correlation coefficient, regression coefficients and ANOVAs.

**Results:** 23 subjects were included. Intrarater reliability was acceptable for the five gait parameters. All gait parameters but frontal hip angle presented acceptable interrater reliability. Valid gait parameters when estimated in their units were step width, duration of stance phase, and – only when assessed on a categorical scale – sagittal knee angle. Increased hip flexion at initial contact and increased weight acceptance on the affected leg could improve gait speed.

**Conclusion:** All five gait parameters are considered reliable when used repeatedly by the same physiotherapist. Three gait parameters are considered reliable when used by physiotherapists interchangeably, and valid. The use of a smartphone application can add value in some situations. Two of the five gait parameters impacted gait speed.

**Keywords:** Stroke, Gait Analysis, Validation study, Psychometrics

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# Development and Implementation of an Interprofessional, Evidence-Based Mobilisation Protocol for Early Neurorehabilitation

**Background:** One of the most important goals of early neurorehabilitation is to reach the highest possible level of independence by restoring functions such as mobility. Recent literature highly recommends early mobilisation including specific frequency and duration of interventions. In Switzerland, evidence-based mobilisation protocols are not routinely implemented in intermediate care units (IMCU).

**Purpose:** The aim of this implementation study is the development and implementation of an evidence-based, interprofessional mobilisation protocol for patients suffering from strokes, traumatic brain injuries and spinal cord injuries.

**Methods:** The knowledge to action process (KTA) was used for the development of the mobilisation protocol and the implementation process. More specifically, the ADAPTE methodology, which is included in the KTA, was used for the development of the mobilisation protocol. The success of the implementation was determined by the feasibility and acceptability of the mobilisation protocol. To quantify the feasibility, proportional tests of the intensity of verticalised mobilisations of 16 patients were analysed. The acceptability was analysed by 11 members of the interprofessional team of the IMCU. Correlation analyses of factors potentially influencing the success of implementation were performed.

**Results:** Daily 300 minutes of rehabilitation with task-specific exercises and therapeutic nursing care were recommended by literature, a mobilisation protocol including at least four daily verticalised mobilisations according to the mobility level of the patient in order to challenge him with task-specific exercises. Only 8% of verticalised mobilisations reached the target frequency, and 5 to 42% of verticalised goal-oriented mobilisations reached the target duration. The acceptability rate was 82%. Very weak to weak correlations were found between the potential influencing factors and the intensity of the verticalised mobilisations.

**Conclusions:** The literature search has enabled the development of specific clinical recommendations for mobilisation in early neurorehabilitation. The implementation was partially successful because the feasibility of this mobilisation protocol could not be confirmed in a relevant way because of a high rate of missing values. Further research is needed to evaluate the feasibility in order to investigate thereafter the effectiveness of this type of mobilisation protocol.

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## Wie nehmen Eltern von frühgeborenen Kindern physiotherapeutische Handlungs-Instruktionen auf der Neonatologie wahr? – Eine Qualitative Studie

**Hintergrund:** Die extreme Frühgeburt eines Kindes und die Ausnahmesituation verbunden mit einer langen Aufenthaltsdauer für die Eltern und Kinder in einem unbekanntem, hochtechnisierten Umfeld verursachen eine herausfordernde Situation für die Bindung und Interaktion zwischen dem Kind und seinen Eltern. Die Physiotherapie auf der Neonatologie gilt als Spezialgebiet und unterscheidet sich in der Deutsch-Schweiz nach klinikinternen Richtlinien. In dieser Studie wurde die Wahrnehmung der Eltern von angeleiteten physiotherapeutischen Handlings-Instruktionen in der Zeit auf der grössten Neonatologie der Deutsch-Schweiz hinsichtlich Kompetenzentwicklung und Umgang mit dem frühgeborenen Kind untersucht.

**Methode:** Es wurden fünf Familien unterschiedlicher Hintergründe, die mindestens eine dreimalige Handlings-Instruktion von der Physiotherapeutin mit ihrem frühgeborenen Kind erhalten hatten, drei bis sechs Wochen nach stationärem Austritt interviewt. Die Erhebung der Daten erfolgte mittels eines semi-strukturierten Leitfadenterviews. Eine phänomenologisch-hermeneutische Analyse wurde zur Auswertung durchgeführt.

**Resultate:** Die Wahrnehmung und das Erleben der Eltern liess sich in fünf Haupt,- und Unterthemen sichtbar machen. Die Eltern erlebten während der Zeit auf der Neonatologie die Physiotherapie als sinnhaft und Bewegung des frühgeborenen Kindes generell als bedeutend und wichtig. Das Verständnis für die angeleitete Handlings-Instruktion entstand über Zielsetzungen für das Kind und durch einen frühen, direkten Miteinbezug der Eltern in die Aktivität. Die Wirkung der Aktivitäten veränderte die Interaktion mit dem Kind und unterstützte die Eltern handlungsfähig zu werden. Es konnte ein Transfer der ausgeführten Aktivitäten in den Alltag beobachtet werden.

**Schlussfolgerung:** Insgesamt wurde die Physiotherapie in Form von angeleiteten Handlings-Instruktionen von den Eltern als positiv und unterstützend wahrgenommen und förderte das Selbstvertrauen für den Umgang mit dem frühgeborenen Kind.

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# The Perspective of Health Care Professionals Regarding the Meaning of IPC in a Comprehensive Health Care of People With Multiple Sclerosis in Switzerland. A Qualitative Focus Group Study.

**Background:** Multiple sclerosis (MS) is an idiopathic inflammatory autoimmune disease of the CNS. Worldwide, 2.5 million people have been diagnosed with MS. It is a chronic, life-long and degenerative disease who is typically present in adults ranging from 20 to 45 years of age. Most people with MS (PwMS) experience more than one symptom during the course of the disease, but in individual combinations. This means that patient needs change over time due to its shifting disabilities and have a need in a complex and coordinated rehabilitation health care. Due to the complexity of MS a broad variety of patient-centered needs becomes clear, therefore an approach of interprofessional collaboration (IPC) and a comprehensive health care management between patient and multiple health care professionals (HCP) is necessary to treat this disease and take care of the different needs as comprehensive as possible. The aim of this study is to explore the perspective of specific HCP (physiotherapist, speech and language therapist and occupational therapist) and the meaning of IPC in a comprehensive health care of PwMS.

**Methods:** To answer the research question, a qualitative phenomenological approach was used. A study based on focus group (FG) interviews with HCP was conducted between August and September 2018. FG's were hold in Swiss-German and recorded acoustically and transcript verbatim into High German.

**Results:** The sample contained HCP three different of clinics in different cantons in the German speaking part of Switzerland specified for PwMS in different phases of care and rehabilitation. Following main sets emerged: Experience with IPC, relevant aspects for IPC when treating PwMS, differences stationary and ambulant and influence of patient perspective on IPC.

**Conclusion:** It is clear from the findings of this research that IPC plays a crucial role in HCP perspective in treating PwMS. PwMS overall only benefit from an IPC therapeutic approach because HCP work together goal-oriented and patient centered. It could be shown that the close location (inpatient setting) of the individual HCP strongly supports the implementation of the IPC.

**Keywords:** interprofessional collaboration, people with MS, health care professionals

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# In Vitro Robotic Biomechanical Testing of the Anterolateral and Anterior Cruciate Ligament: a Human Cadaveric Study

Prior biomechanical studies showed functional and structural properties of the anterior cruciate ligament (ACL) and anterolateral ligament (ALL) of the knee. Rotatory instability often occurs following isolated ACL reconstruction.

The aims of this controlled laboratory study were: (i) analyse the biomechanical function of the ALL and ACL; and (ii) elucidate 2 techniques for ALL and 1 for ACL reconstruction.

Six fresh-frozen cadaveric knees were tested using a 6 degrees-of-freedom robotic system. The anterior translation with a 134 N force and the internal rotation with a 5 Nm torque were performed from 0° to 90° knee flexion. The Pivot Shift Test was measured at 15° and 30° knee flexion under 5 Nm internal and 10 Nm valgus torque. Following order and conditions was used: Native, ACL deficiency (cACL), ACL+ALL deficient (cACLcALL), ACL reconstructed (rACL), ACL+ALL reconstructed with Lemaire technique (rALL-Lemaire), ACL+ALL reconstructed with Sonnery-Cottet technique (rALL-Sonnery).

Finally, the ALL has a positive effect on anterior translation. Both ACL and ALL reconstructions came during internal rotation closest to the native state. The cACLcALL state had an increased axial plane translation and internal rotation during the Pivot Shift Test.

In conclusion, the ALL plays a role in controlling rotational stability in cadaver knees.

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# Die Rolle der dominanten unteren Extremität bei der Beurteilung des Gleichgewichts – eine Metaanalyse

**Hintergrund:** Das Gleichgewicht ist eine notwendige Voraussetzung für verschiedene Aktivitäten und Sportarten. PhysiotherapeutInnen beurteilen und trainieren daher regelmässig Gleichgewichtskapazitäten mit ihren PatientInnen. Verschiedene Gleichgewichtstests sind vorhanden und um ihre Resultate zu interpretieren, wird häufig ein Vergleich mit normativen Daten gemacht. Nach einer Verletzung oder einer Operation werden regelmässig die Resultate der verletzten unteren Extremität mit der gesunden unteren Extremität verglichen. Unklar ist jedoch, ob die Dominanz eines Beines die Gleichgewichtskapazitäten im Einbeinstand beeinflusst. Wenn das der Fall ist, müsste dies bei der Interpretation der Testresultate berücksichtigt werden.

**Ziel:** Ziel der Studie war es, die vorhandene Literatur zu analysieren, um herauszufinden, ob die Gleichgewichtskapazitäten durch die Dominanz der einen unteren Extremität beeinflusst werden.

**Methode:** Die Literaturrecherche wurde in PubMed, CINAHL, Cochrane und Embase durchgeführt. Daten der eingeschlossenen Studien wurden in einer standardisierten Form extrahiert. Die Metaanalyse wurde mit einem Random Effekt Modell ausgeführt.

**Resultate:** Neununddreissig Studien wurden eingeschlossen. Die Daten wurden in 7 Kategorien von Gleichgewichtstests eingeteilt. Keine Kategorie zeigte signifikante Unterschiede zwischen der dominanten und der nicht-dominanten unteren Extremität (stabiler Untergrund, offene Augen:  $-0.04$ , 95% KI  $-0.13$  bis  $0.05$ ; stabiler Untergrund, geschlossene Augen:  $-0.09$ , 95% KI  $-0.26$  bis  $0.08$ ; labiler Untergrund, offene Augen:  $-0.09$ , 95% KI  $-0.30$  bis  $0.12$ ; labiler Untergrund, geschlossene Augen:  $-0.06$ , 95% KI  $-0.27$  bis  $0.15$ ; BESS:  $0.03$ , 95% KI  $-1.09$  bis  $1.14$ ; SEBT/ YBT:  $0.06$ , 95% KI  $-0.08$  bis  $0.19$ ; Sprünge:  $0.04$ , 95% KI  $-0.28$  bis  $0.36$ ).

**Bedeutung:** Die Resultate weisen darauf hin, dass die Gleichgewichtskapazitäten nicht von der Dominanz einer unteren Extremität beeinflusst werden. Das bedeutet, dass die Leistungen der beiden unteren Extremitäten unabhängig der Dominanz, als Referenz benutzt werden können. Bezüglich des Gleichgewichts im Einbeinstand ist die Evidenz stark. Weitere Studien sind jedoch nötig, um die Resultate bezüglich der Stabilisation auf einem Bein nach einem Sprung zu bestätigen.

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# Vibro-Tactile Biofeedback of Trunk Sway to Improve Balance Control in Patients With Relapsing-Remitting and Primary-Progressive Multiple Sclerosis

**Introduction:** Individuals with multiple sclerosis (MS) often suffer from diminished balance. This might be due to leg proprioceptive loss as noted by decreased somatosensory evoked potentials. Two previous studies have already demonstrated the effect of training with vibro-tactile biofeedback in individuals with MS. The aim of this study was to investigate the effect of four weeks of training with vibro-tactile biofeedback and how long the participants can profit from the training that is, the duration of the after-effect.

**Methods:** 13 participants were included and their balance control tested with the SwayStar<sup>TM</sup> device. They received vibro-tactile biofeedback training during balance exercises with the BalanceFreedom<sup>TM</sup> system. The training was conducted twice a week for four weeks. Additionally, post-training assessments were conducted once a week for four weeks after the training ended, and once after six months.

**Results:** During the four weeks of training, there was an improvement in a global balance control index, the duration of walking three meters with eyes closed, roll angle for walking 8 tandem steps and the pitch angle when standing on foam with eyes closed. In addition, the questionnaire scores for the dizziness handicap inventory and multiple sclerosis walking scale-12 improved significantly. The main improvement occurred during the first week of training. The effect remained stable for four weeks after the training had ended; however, it was not present six months after the training.

**Conclusion:** This study showed a positive effect of vibro-tactile biofeedback training on balance control in participants with MS. A training period of minimum three weeks can be recommended for future interventions. The results are similar to those of previous studies. After six months the effect is no longer present.

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# Wenn Muskeln den Verstand verlieren: Kortikomuskuläre Kohärenz bei älteren Personen

**Hintergrund /Ziele:** Im Alter entstehen motorische Defizite und Stürze werden häufiger. Strukturelle Veränderungen führen zu einer Abnahme der neuro-muskulären Kontrolle. Eine Möglichkeit um die Aktivität des Gehirns und der Muskulatur zu messen, ist die Messung der kortikomuskulären Kohärenz. Dabei wird der Grad der Übereinstimmung der Aktivität der Muskulatur und des Gehirns ermittelt. Das Ziel der Studie war, die Machbarkeit eines Messprotokolls der kortikomuskulären Kohärenz bei älteren gefähigen Personen während des Gangzyklus zu prüfen.

**Methodik:** Acht ältere, gefähige Personen ohne neurologische Erkrankungen und ohne mentale Defizite wurden inkludiert. Die Muskulatur (M. Soleus, M. Tibialis anterior, M. Gastrocnemius medialis und lateralis) des dominanten Beines wurde mittels EMG System gemessen, der motorische Kortex mittels EEG System (64 Elektroden). Die Probanden absolvierten die Messung in Form einer Acht (40 Runden) und der Zeitpunkt des Fersenaufschlag wurde für die Analyse der kortikomuskulären Kohärenz verwendet. Zusätzlich wurden die Probanden nach der Akzeptanz der Messung befragt.

**Resultate:** Aufgrund der Artefakte bei den Messresultaten konnte keine neuronalen Aktivitäten herausgefiltert werden und deshalb konnte die kortikomuskuläre Kohärenz nicht berechnet werden. Es wurden zu viele Störsignale aufgenommen. Es wurde keine erfolgreiche Machbarkeit des Messprotokolls erreicht. Die Probanden zeigten eine hohe Akzeptanz der Messung.

**Diskussion/ Schlussfolgerung:** Genauere Messprotokolle und Messsysteme sind nötig, um eine Aussage über die kortikomuskuläre Kohärenz bei älteren Personen während des Gangzyklus zu machen.

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# Spinal Motion During Functional Activities in Patients With Non-Specific Chronic Low Back Pain: a Pilot Study

**Background:** Non-specific chronic low back pain (NSCLBP) has been associated with altered mobility in the lumbar spine. These findings are largely based on relative angles and parameterized as average and range of motion values, which limits motion characteristics. The current study aims at the investigation of spinal motion characteristics during functional activities in NSCLBP patients using spinal curvature angles and advanced statistical methods.

How do spinal motion characteristics differ between NSCLBP participants and healthy controls during functional activities?

**Methods:** Thirteen participants with NSCLBP and 15 healthy controls were equipped with 58 retro-reflective markers and asked to perform the following functional activities: upright standing and sitting, standing up from a chair and sitting down on a chair, lifting up and putting down a 5 kg box, as well as walking and running at a self-selected speed. Kinematics data of the spine and the pelvis were collected using a 10 camera Vicon motion capture system. The group comparisons of spinal and pelvic angle at each time point over a full movement cycle was calculated with one-dimensional Statistical Parametric Mapping. Due to the pilot nature of this study, the alpha-level was set at 0.20.

**Results:** NSCLBP patients demonstrated significantly less anterior pelvic tilt (Standing:  $p=0.001$ ; Chair rising:  $p=0.164$  resp.  $p=0.194$ ; Object lifting:  $p=0.087$  resp.  $p=0.198$ ) and decreased lumbar lordosis angle (Standing:  $p=0.063$ ; Object lifting:  $p=0.123$ ) in the sagittal plane in upright standing positions during the activities. Patients tended to lift and put down a box with an increased kyphosis in the thoracic spine. During walking and running a larger lordosis in the thoracolumbar area was observed in the patients. In running, a paradox sagittal lumbar motion pattern ( $p=0.144$  resp.  $p=0.162$ ) and a significantly less anterior tilt ( $p=0.174$  resp.  $p=0.014$ ) in the mid-stance phase were observed.

**Significance:** This results showed that the NSCLBP patients change the spinal and pelvic characteristics during activities and compensate in other spine areas with increased impact.

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# The Course of Acute Low Back Pain: a Longitudinal Study of Psychosocial Factors and Their Influence on Pain, Disability, and Movement Control

This paper extends existing approaches in investigations of acute low back pain. A new combination of factors examines the relationship between psychological and biomechanical aspects to pain. Although, pain is individually experienced various pain responses pattern are widely accepted. Knowledge of whether more psychological or biomechanical factors contribute to ongoing pain is important for pain management and prevention strategies.

A 6-months prospective observational study of 4 repeated measurements with concurrent patient-reported outcomes (Pain, Disability, Pain-response pattern), and a test of 6 active movement control of the lumbopelvic region was carried out. Sixty-six participants were categorized by their individual pain-response based on the Avoidance-Endurance Questionnaire (AEQ).

The AEQ categorization revealed 2 subgroups representing patterns of endurance response (ER; n=34) and of adaptive response (AR; n=17). The ER group had 1.4 times more cases of chronicity than the AR group at 3 months, and 5.5 times more in the ER than in the AR at 6 months. A 2-way repeated-measures analysis of variance revealed a significant time effect for pain and disability, yet not for movement control. There were no significant interactions of the 2 groups with pain, disability, and movement control. Spearman's Roh revealed weak correlation between pain and movement control.

Psychosocial factors, as well as pain intensity had no influence on movement control dysfunction. However, the findings indicate that endurance response leads to higher pain, and disability, and more cases of chronicity than adaptive response. The results fortify approaches in primary care on the base of bio-psychosocial treatments.

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# Measuring Spinal Motion With the Epionics SPINE System: Concurrent Validity as Well as Intra-Session and Between-Session Reliability

Quantifying spinal motion during functional activities may contribute to a better understanding of common pathologies such as spinal disorders. Therefore, the current study aimed at the quantitative evaluation of the Epionics SPINE system, a portable and cost-effective device for measuring sagittal lumbar movement during functional activities. Twenty healthy participants were equipped with the Epionics SPINE and a Vicon motion analysis system during two identical but separate research visits. They performed the following activities: standing, sitting, chair rising, box lifting, walking, running and a counter movement jump (CMJ). Sagittal plane lumbar spine angles were extracted as continuous values, average and range of motion (ROM) parameters. Agreement between the systems was evaluated using Bland-Altman analyses, whereas intra-session and between-session reliability were assessed using intraclass correlation coefficients (ICC) and minimal detectable changes (MDC). Average and ROM values showed excellent agreement between the systems for chair rising, box lifting and CMJ (mean-differences < 4°) and moderate agreement for walking and running (mean-differences < 11°). Reliability was moderate to high for all parameters (ICC ≥ 0.62), except for ROM during running (ICC = 0.29). MDCs ranged from 2.5-14° (intra-session) to 1.9-18° (between-session). Considering continuous values, device agreement was also high, but Epionics SPINE systematically underestimated lordosis angles during walking and running. ICCs indicated high reliability for all activities (ICC > 0.75). Peak MDCs reached 20° within and 25° between the sessions. The Epionics SPINE system performed similarly to the gold standard and showed high consistency within and between measurement sessions for chair rising, box lifting and CMJ and slightly lower outcomes for walking and running.

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# Goal-Oriented Therapy Planning in Neurorehabilitation: Adherence to Personalized Treatment Pathways in Subacute Stroke – a Feasibility Study

**Background:** Clinical pathways following evidenced-based medicine reduce costs and improve quality of life in stroke rehabilitation. Nevertheless, patients are unsatisfied. The suspected reason for dissatisfaction is the lack of inclusion of needs. This study proposes a novel, goal-oriented therapy planning method using an ICF-based multidisciplinary assessment and subject-specific input from healthcare professionals to personalize the treatment plan during rehabilitation.

**Objective:** The aim of this feasibility study was to investigate whether this novel therapy planning method can be adhered to in rehabilitation of patients with a stroke.

**Methods:** 25 patients with subacute stroke were recruited. A novel procedure was used to create a personalized therapy plan. The primary outcome was adherence measured in deviations from the target therapy plan. Feasibility was assumed if deviations were <5%. A univariate descriptive analysis was performed.

**Results:** Relative deviations of the target therapy plans were: -47.6% (NP), -49.77% (OT) and -83.14% (ST) indicating that the feasibility of the novel procedure was not guaranteed. In PT relative deviation was +7.82% indicating partial feasibility.

**Conclusions:** Through modifications (e.g. expansion of group therapy offers and use of robot-assisted therapy) the novel procedure should become a standardized method in neurorehabilitation.

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# Effect of Whole Body Vibration on Voluntary Muscle Activation and Spasticity in Children With Cerebral Palsy. A Cross-Over Randomized Pilot Study. Importance for physiotherapy.

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**Purpose:** This study examined the effect of a 3-minute whole-body vibration on neuromuscular activity (VA) in children with cerebral palsy (CP)

**Methods:** Twenty children with CP ages 3 to 16 years, level-I on the Gross Motor Function Classification System, participated. Assessments after treatment or sham treatment were the VA of the lower leg muscles during maximal voluntary muscle activation, the Modified Tardieu Scale (MTS), Range of Motion (ROM) of the ankle joint and spatiotemporal gait-parameters.

**Results:** Enhancements of pre- to post measurements are significant for all muscle groups ( $p = 0.00$ , Alpha = 0.025, effect size 0.62) for VA after both treatments. The MTS decreased for all muscles, whereas the ROM and gait-parameters increased for both treatments.

**Conclusion:** In contrary to our expectations, the results for treatment as well as for sham treatment showed significant differences after whole-body vibration. Values remained at an equal level after physiotherapeutic treatment for both.

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## Effects of Stochastic Vibrotactile Stimulation on Speed Modulation During Optic Flow

**Background:** People with reduced tactile sensitivity walk slower and show abnormalities in gait patterns. Manipulation of the visual field via accelerated or decelerated optic flow stimuli results in walking speed adaptations which are exacerbated in patients with Parkinson Disease or stroke. Stochastic vibrotactile stimulation on the foot sole reduces the sensory threshold, leading to decreased postural sway and variability during walking. However, there is little known on how magnitude and duration of the optic flow's effect depend on sensitivity. Therefore, we investigated the influence of stochastic vibrotactile stimulation on the speed modulation induced by optic flow and its effects.

**Methods:** Kinematic data of 24 healthy individuals were recorded while walking with vibratory shoe soles delivering subsensory white-noise stimulation to the feet on a self-adaptive treadmill with manipulated optic flow. Main outcomes were walking speed [m/s], step length [cm], step frequency [steps/min] and step width [cm].

**Results:** Optic flow showed a significant effect on speed modulation whether with (-8%Baseline) or without (-6%Baseline) stochastic vibrotactile stimulation, but no effects were observed in walking speed, step length and step width. However, stochastic vibrotactile stimulation induced a significant decrease in step frequency modulation (2.0 - 4.1%Baseline,  $p = 0.013$ ). There was no relationship between tactile sensitivity and modulation in walking speed, step length, step frequency and step width.

**Discussion:** The findings revealed that applying of stochastic vibrotactile stimulation during walking with optic flow impacts step frequency to a larger extent than step length. This may indicate that these mechanics are controlled separately whereby step frequency is more directly modulated by peripheral sensations while step length is dominated by supra-spinal processes. Further investigation of stochastic vibrotactile stimulation in people with reduced tactile sensitivity, where impaired transmission is known, may provide information of how changes in afferent signaling are regulated.

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# Perceptions Towards Physical Activity in Lung Transplant Recipients With Cystic Fibrosis

**Background:** Regular physical activity (PA) is an important component in lung transplant aftercare. However, barriers and facilitators towards PA in lung transplant recipients with cystic fibrosis (CF) are largely unknown. The aim of this study was to investigate perceptions towards PA in lung transplant recipients with CF to better understand patient needs and preferences.

**Methods:** In the cross-sectional study, CF patients after lung transplantation (LTx) completed an online survey at four Swiss aftercare centres between June and December 2018.

**Results:** The survey was completed by 111 patients with a response rate of 87.4%. Overall, patients perceived PA as very important for their daily life and health (0-6 Likert scale, median 5 IQR(4;5), median 5 IQR(5;6), respectively). Most reported facilitators towards PA were to feel better, achieve personal goals, improve quality of life, muscle strength, and endurance, and have more energy for everyday life and fun. Barriers included lack of motivation and time, fatigue and too little energy/power. Barriers and facilitators towards PA varied depending on time after LTx. Patients with lung allograft dysfunction (LAD, n=20) were less physically active ( $p=0.009$ ), reported lower patient-reported health status ( $p=0.011$ ) and rated barriers shortness of breath, bad weather and concerns about lung rejection higher than those without LAD (all  $p<0.05$ ). The majority of participants would prefer individual unsupervised (60%) endurance training (90%), outdoor (77%) once or twice a week (47%) 40-60 minutes (48%).

**Conclusions:** The present survey highlights patient-reported barriers and facilitators towards PA and may facilitate the establishment of patient-centred training programmes

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# Gait Balance in Children With Cerebral Palsy During Dual Tasks

**Aim:** The aim of this prospective cross-sectional study with matched control was to measure the effect of dual tasks on the gait stability of children with cerebral palsy (CP) and to compare their capabilities with the ones of typically developing (TD) children.

**Methods:** The children of both CP (n= 20) and TD groups (n=20) had to walk first without cognitive constraint, then while counting and finally while naming alternatively animals and fruits (DTf/a). Afterwards, they completed the same cognitive exercises while sitting. We calculated their foot placement estimator (FPE) and their walking speed in a gait laboratory using an optoelectronic system. Cognitive scores also were computed. Comparisons within and between groups were analysed with paired t-tests when the data were normally distributed and with a non-parametrical test when it was not the case. The influence of speed was examined with a Pearson correlation.

**Results:** The CP group shortened the distance from FPE to foot in the anteroposterior direction (DFPEAP) and lengthened it in the mediolateral direction during dual tasks. Walking speed correlation with DFPEAP was mainly present in the CP group.

**Interpretation:** Children in both groups showed significant changes in gait stability under dual tasks theoretically due to a sharing attention between gait and the cognitive task. All children favoured a 'posture second' strategy during the dual task of naming alternatively animals and fruits.

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# Effect of Tool-Use Observation on Body Representation and Peripersonal Space in Young Healthy Adults

**Background:** Accurate and updated representations of the space where the body acts, i.e. the peripersonal space (PPS), and the shape and dimension of body parts (metric body representation, BR) are essential to perform actions. Previous evidence has shown that these representations are highly flexible, being modulated by sensorimotor experiences, such as the active use of tools to reach objects in the far space. Observing someone else acting with a tool in far space may also impact the BR and the PPS. However, to date, there is contrasting evidence between PPS and BR remapping after observational tool-use. In this study, we investigate, whether the observation of another person using a tool to interact with objects located in the far space is sufficient to influence the plasticity of PPS and BR representation in a similar way to active tool-use.

**Method:** In four separate and randomized sessions, twenty-two young healthy adults were asked to perform a behavioural task to evaluate PPS or BR before and after a twenty minutes training either based on the active use of a tool to retrieve far cubes or on the observation of an experimenter doing the same tool-use training.

**Results:** The results suggest no significant modulation in the PPS representation both after active or observational tool-use training. On contrary, the effects on BR differ after active tool-use training compared with the observational one. While after active tool-use participants reported an extended perceived length of the arm, in line with previous works in the field, no significant differences were found after observation.

**Discussion:** This dissociation found in the active and observational tool-use points out differences between action execution and action observation on BR plasticity and contributes to reconsider those differences in our clinical daily practice. Indeed, a mere observational training could not be sufficient to modulate BR.

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# Evaluating Feasibility of MyoSuit in a Physiotherapeutic Rehabilitation Environment

**Background:** Mobility in daily life is an essential element when considering quality of life. Factors that contribute to mobility difficulties are varied and include age and health problems (neurological and muscular). By keeping a mobile life, health factors such as blood pressure, range of motion of the joints, bladder health, skin integrity, spasticity and pain would be improved. Using therapeutic devices which facilitate mobility is a helpful solution to improve mobility. An exoskeleton is a wearable powered lower limb robotic orthosis which assists performing activities. But there are some issues that restrict their application. To overcome some of these issues, exosuits have been developed. MyoSuit is a soft textile interface exosuit which provides support during different activities.

**Objective:** The goal of this thesis is to evaluate the feasibility of using MyoSuit in a physiotherapeutic environment. The device was tested to investigate: 1. practicability (time to done and doff, usability, adverse effects and safety) 2. acceptability (pain, injury and fatigue) of the device.

**Methods:** Five participants with neurological disease(s) were tested for evaluation. While doing physiotherapy sessions (endurance, balance and strength) the evaluations have been performed.

**Result:** All participants completed the study. In practicability: the donning time was not achieved, no adverse effect happened and the usability was approved. In acceptability: fatigue increased lightly, no skin incidences and no pain was recorded.

**Conclusion:** The results suggest the feasibility of using Myosuit as a physiotherapeutic device with some changes. Improving the donning part is needed and fatigue needs to be observed.

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