Amsterdam Movement Sciences

Abstracts

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Poster № 1

RGD IMMOBILIZATION ON CARBOXYL SURFACE-FUNCTIONALIZED ELECTROSPUN POLY-E-CAPROLACTONE SCAFFOLDS PROMOTES ENDOTHELIALIZATION AND ANTI-THROMBOTIC ACTIVITY IN A PERFUSION BIOREACTOR

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Introduction: Rapid endothelialization, endothelial cell stability, and prevention of thrombus formation by nitric oxide (NO) production, at the lumen of vascular electrospun poly-ε-caprolactone (PCL) scaffolds under flow is a challenge. Surface-functionalization of PCL scaffolds with negatively-charged carboxyl (COOH), or positively-charged amine (NH_2) groups followed by immobilization of arginine-glycine-aspartate (RGD) onto a scaffold surface affects endothelialization and cell stability. However, whether RGD-immobilization on COOH surface-functionalized electrospun PCL scaffolds is more effective than on NH_2 surface-functionalized scaffolds under blood flow is unknown.

Purpose: To test whether RGD-immobilization on COOH or NH_2 surface-functionalized electrospun PCL scaffolds affects endothelialization, endothelial cell stability, and NO production in a perfusion bioreactor mimicking blood flow.

Methods: Human umbilical vein endothelial cells (HUVECs) were seeded on electrospun PCL scaffolds surface-functionalized by COOH or NH_2 groups followed by RGD immobilization, and cultured up to 8 days in a static or perfusion bioreactor. Scaffolds' physicochemical properties, and endothelial cell function (proliferation, endothelialization, endothelial cell stability, and NO production) were investigated.

Results: COOH and NH_2 surface-functionalization followed by RGD immobilization decreased fiber diameter (0.4-0.5-fold) and water contact angle (0.3-0.7-fold), but increased pore size (1.7-2.1-fold) and porosity (1.2-fold). COOH and NH_2 surface-functionalization followed by RGD immobilization increased cell proliferation (2.2-5.6-fold) and collagen deposition (1.4-1.7-fold) in a perfusion bioreactor after 8 days **(Fig. 1)**. COOH and NH_2 surface-functionalization followed by RGD immobilization increased cellular NO production (1.2-4.2-fold) after 30 min in a perfusion bioreactor. Cells were more stable on COOH surface-functionalized RGD immobilized scaffolds after 1 h in a perfusion bioreactor.

Conclusions: Maximum endothelialization, cell stability, and NO production was observed on carboxyl surface-functionalized electrospun PCL scaffolds followed by RGD immobilization, which might be an excellent candidate for long-term application of endothelial cells to prevent thrombus formation at the lumen of artificial vascular grafts under blood flow.

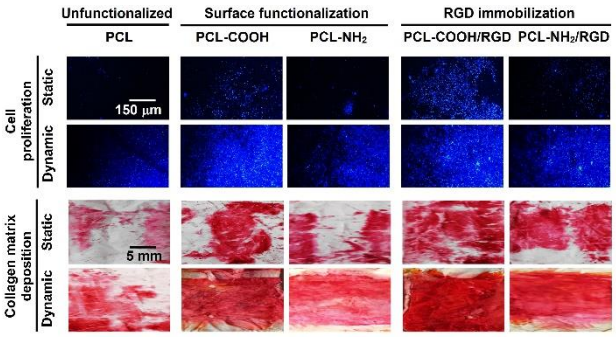

Figure 1. HUVEC proliferation and collagen production on COOH or NH_2 surface-functionalized RGD-immobilized electrospun PCL scaffolds in a static or perfusion bioreactor after 8 days. PCL; poly-ε-caprolactone; COOH: carboxyl; NH_2: Amine.

Poster № 2

(HIIT-THE TRACK) HIGH INTENSITY INTERVAL TRAINING FOR PEOPLE WITH PARKINSON'S DISEASE: INDIVIDUAL RESPONSE PATTERNS OF (NON-)MOTOR SYMPTOMS AND BLOOD-BASED BIOMARKERS – A CROSSOVER SINGLE-CASE EXPERIMENTAL DESIGN

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Introduction. Physical exercise receives increasing interest as an augmentative non-pharmacological intervention in Parkinson's disease (PD) as pharmacological treatment insufficiently alleviates disease burden and daily functioning is increasingly limited by adverse drug effects. Considering gradual worsening of symptoms and subsequent threat to participate in everyday activities, independent living, and quality of life, there is a need for additional non-pharmacological interventions to alleviate disease burden and preferably modify progression.

Purpose This pilot study primarily aimed to quantify individual response patterns of motor symptoms to alternating exercise modalities, along non-motor functioning and blood biomarkers of neuroplasticity and neurodegeneration.

Methods People with PD performed high intensity interval training (HIIT) and continuous aerobic exercise (CAE) using a crossover single-case experimental design. Repeated assessment of outcome measures was conducted. Trajectories of outcome measures were visualized in time series plots and interpreted relative to the minimal clinically important difference (MCID) and smallest detectable change (SDC) or as a change in the positive or negative direction using trend lines.

Results Data of 3 participants were analyzed and engaging in physical exercise seemed beneficial for reducing motor symptoms. Participant 1 demonstrated improvement in motor function, independent of exercise modality; while for participant 2 such a clinically relevant (positive) change in motor function was only observed in response to CAE. Participant 3 showed improved motor function after HIIT but no comparison could be made with CAE because of drop-out. Heterogeneous responses on secondary outcome measures were found, not only between exercise modalities but also among participants.

Conclusions Though this study underpins the positive impact of physical exercise in management of PD, large variability in individual response patterns to the interventions among participants makes it difficult to identify clear exercise-induced adaptations in functioning and blood biomarkers. Further research is needed to overcome methodological challenges in measuring individual response patterns.

Poster № 3

MORE GLYCOLYTIC FIBERS PARTLY EXPLAIN THE EXERCISE INTOLERANCE IN PATIENTS WITH POST COVID-19 CONDITION

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Introduction: A subset of people who contract acute coronavirus disease 2019 (COVID-19) experience long-term symptoms, also called post COVID-19 condition (PCC). A thriving hypothesis for PCC is mitochondrial dysfunction. On the other hand, due to inability to exercise, patients with PCC become more inactive. This may cause a skeletal muscle fiber-type shift from predominantly type I to type II which could be an additional possible explanation for the exercise intolerance shown in previous research.

Purpose: This study aimed to determine fiber-type distribution and succinate dehydrogenase (SDH) activity of patients with PCC and healthy controls. Secondly, SDH-activity and the fiber cross-sectional area (FCSA) were related to respectively VO2-peak and peak power output obtained during an incremental cycle test.

Method: Muscle biopsies of the vastus lateralis were obtained from 23 patients with PCC and 21 healthy controls, before and after the exercise test. Immunofluorescence staining of myosin heavy chain and SDH was used to respectively assess fiber-type composition and SDH-activity.

Results: Skeletal muscle from patients with PCC contained more type IIx (p=0.034) and hybrid fibers (*, p=0.005) compared to controls (fig.1A+B), while type I (p=0.172) and type IIa (p=0.094) tended to be lower. The FCSA of the different fiber types was not significantly different between both groups, but type I FCSA tended to be lower (p=0.107). The weighted FCSA was positively correlated to peak power output (fig.1C) in both patients (r=0.609, p=0.002) and controls (r=0.505, p=0.019), however the intercept differed significantly (p=0.020). The time x group interaction (p=0.008) for SDH-activity was reflected by a lower post-exercise SDH-activity of patients with PCC compared to controls (p=0.006). SDH-activity was significantly correlated to VO2-peak in controls (r=0.65, p=0.001) but not in PCC patients (r=-0.10, p=0.659).

Conclusions: Patients with PCC showed significantly higher amounts of highly fatigable IIx-fibers compared to healthy controls. Additionally, it seems that patients with PCC were not able to reach the same peak power output with the same FCSA as healthy controls. Our data suggest an additional (unknown) factor other than mitochondrial function to contribute to exercise intolerance in patients with PCC.

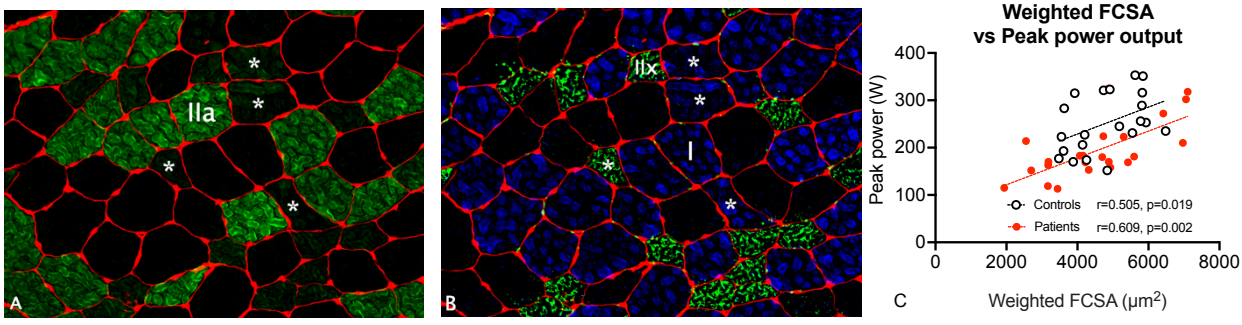

Figure 1. A+B Fiber-type distribution of a patient with PCC.

Poster № 4

LOWER MITOCHONDRIAL RESPIRATION IN POST-COVID-19 CONDITION PATIENTS WITH POST-EXERTIONAL MALAISE

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Introduction: While many patients with COVID-19 successfully recover, a substantial portion continue experiencing symptoms beyond 3-months, which is known as Post-COVID-19 Condition (PCC). Patients with PCC often present with unexplained muscle-related ailments, most predominantly post-exertional malaise (PEM), which is the worsening of symptoms following physical or mental exertion. PEM is idiopathic, however it has been proposed that β-amyloid deposits may induce PEM by blocking vasculature or by impeding mitochondria.

Purpose: The present study aimed to investigate the mitochondrial respiration of patients with PCC compared to controls. Additionally, the study aimed to quantify the correlation between β-amyloid and respiration parameters, specifically respiration states and mitochondrial enzyme activity.

Methods: Skeletal muscle biopsies were obtained from the *vastus lateralis* muscle of both patients with PCC and healthy controls prior to a cardiopulmonary exercise test (CPET) and 24-hours following induction of PEM by CPET. Biopsy samples were allocated for respiration measurements and immunohistochemical staining. Mitochondrial respiration was assessed using a substrate-uncoupler-inhibitor titration protocol. Biopsies were also sectioned into 10µm thick sections, and then stained for β-amyloid and succinate dehydrogenase (SDH) enzymatic activity. Data were compared between patient and control groups and between time points.

Results: Patients with PCC exhibit reduced leak ($p=0.02$), NADH-linked ($p<0.001$), oxidative phosphorylation ($p<0.001$), maximal oxidative capacity ($p<0.001$), succinate-linked respiration ($p<0.001$), and coupling control ratio ($p=0.001$). Exercise did not induce a reduction in any respiration parameters in either the PCC or control groups. SDH activity was not significantly different between groups ($p=0.06$) and showed no time effect ($p=0.54$). β-amyloid presence was significantly different between groups at both time points, and was correlated with maximal oxidative capacity ($p=0.008$), succinate -linked respiration ($p=0.007$) and coupling control ratio ($p=0.02$).

Conclusion: Patients with PCC have reduced mitochondrial function compared to controls, which is not worsened by exercise. SDH enzymatic activity did not differ between groups, and thus the decreases in respiration are due to impairments of the mitochondria rather than the quantity. β-amyloid deposits were correlated with respiration parameters that primarily implicate complex-II, indicating a possible deficiency in the shuttling of electrons from complex-II towards ATP-synthase.

Poster № 5

OSTEOBLASTS DERIVED FROM HUMAN FIBROBLASTS VIA INDUCED MESENCHYMAL STEM CELLS AS A POTETNIAL CELL MODEL FOR OSTEOGENESIS IMPERFECTA

Authors

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Introduction

Osteogenesis Imperfecta (OI) is a syndromic disorder of bone fragility and skeletal dysplasia primarily caused by defects in the collagen type I genes. Osteoblasts are the collagen-producing cells in the bone tissue presenting an excellent model to investigate the mechanism of bone fragility in Osteogenesis Imperfecta. However, osteoblast acquisition from patients is a rare event due to the invasiveness of the procedure.

Purpose

The aim of the study is to generate osteoblasts from human dermal fibroblasts via induced mesenchymal stem cells (iMSCs). The generation of osteoblasts from human dermal fibroblasts, has the potential to provide an OI-relevant cell model for the study of collagen regulation, osteoblast differentiation and testing of therapies.

Methods

Fibroblasts were dedifferentiated to iPSCs with the introduction of pluripotent markers. The iPSCs were subsequently differentiated to iMSCs via the neural crest cell stage (iNCCs). iNCCs and iMSCs were validated based the expression of cell-specific markers by qPCR. In addition, the iMSCs were validated by their trilineage differentiation to osteoblasts, chondrocytes and adipocytes.

Results

Our results showed the successful dedifferentiation of fibroblasts to iPSCs and their subsequent differentiation to iMSCs via iNCCs. The iNCCs presented increased iNCC-specific markers including *P75*, *AP2α* and *HNK1* and decreased iPSC markers such as *OCT3/4*, showing the successful differentiation of iPSCs to iNCCs. Similarly, the iMSCs were positive for *CD73, CD105* and *CD90* and were negative for the iNCC and haemopoietic markers. The trilineage validation of OI iMSCs to osteoblasts, chondrocytes and adipocytes is currently ongoing.

Conclusion

We have shown that we can differentiate human fibroblasts from both healthy controls and OI patients to iMSCs, and subsequently to osteoblasts. This can potentially serve as a patient-specific cell model for the investigation of OI bone fragility and its pathological mechanism. We are currently exploring the effects of iMSCs seeded on scaffolds made from hydroxyapatite and fetal bone.

Poster № 6

Feasibility of inspiratory muscle training after COVID-19 infection: A pilot study

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Introduction Many patients recovering from COVID-19 experience prolonged physical and cognitive impairments known as post-COVID syndrome. Dyspnea is a severe symptom of post-COVID syndrome. The Royal Dutch Society for Physiotherapy (KNGF) recommends inspiratory muscle training (IMT) as part of the physiotherapeutic (PT) intervention. However, information on the feasibility and characteristics of optimal IMT is lacking.

Purpose We investigated the feasibility of IMT as part of the PT exercise program for patients with persistent, COVID-related dyspnea.

Methods We conducted a mixed-method pilot study. Participants were patients with dyspnea after COVID-19 infection and their physiotherapists. Patients performed daily IMT at home, consisting of 30 repetitions against a pre-set resistance for six weeks. The primary outcome was feasibility assessed as acceptability, safety, adherence, and patient- and professional experience obtained through diaries and semi-structured interviews. The secondary outcome was maximal inspiratory pressure (MIP), measured at baseline and six-week follow-up. Interviews were thematically analyzed. Quantitative data were analyzed descriptively.

Results Sixteen patients participated. Nine patients and two physiotherapists partook in semi-structured interviews. Two patients dropped out before initiating the training due to psychological complaints and throat irritation. Adherence to the training protocol was 73.7% of all IMT sessions, and no adverse events occurred. Protocol deviations were reported as a result of experienced fatigue before completing the 30 repetitions. Median (IQR) MIP changed from 84.7% (34%) of predicted at baseline to 111.3% (66%) at follow-up. Overall, patients valued the simplicity of the intervention and perceived improvements in breathing coordination. The following barriers to performing IMT were identified: “Getting acquainted with the training material” and “Finding the right schedule”. Facilitators were: “Support from physiotherapists” and “Experiencing improvements”.

Conclusions Incorporating IMT in a PT program for patients with post-COVID dyspnea was feasible. Protocol deviations suggest that the training characteristics, such as frequency and intensity, might need adaptation. While IMT may be beneficial in the treatment of post-COVID dyspnea, our study indicates the importance of careful supervision so that training parameters can be adjusted to individual needs and capacity. Future research should investigate the effectiveness of IMT in a larger-scale study among a variety of patients with dyspnea.

Poster № 7

PREDICTING FREEZING OF GAIT WITH MIXED-REALITY TECHNOLOGY: TIMELY, ACCURATE AND AUTOMATIC CUE ACTIVATION IS TECHNOLOGICALLY FEASIBLE

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Introduction Visual cueing applications for mixed-reality technology (**Figure 1**) may have strong potential for alleviating freezing of gait (FOG) in people with Parkinson's disease [1]. Mixed-reality technology maps the headset position as well as one's environment (**Figure 1C**), from which several features may be reliably estimated [2].

Purpose The aim of this study was to examine if mixed-reality headset data allow for a fast and accurate FOG prediction, ideally before it occurs.

Methods Twenty-four people with Parkinson's disease with ON-state FOG walked around in their home environments and wore a HoloLens1 capturing movement and environment data. The mixed-reality display was turned off and sessions were videotaped. Two independent raters annotated the videos. A computationally efficient algorithm was trained, tested and cross-validated for FOG prediction, evaluated in terms of the area under the receiver-operator characteristics curve (AUC), sensitivity, specificity and accuracy.

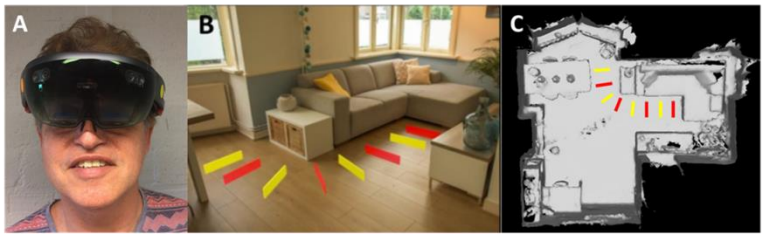

Figure 1 HoloLens1 mixed-reality headset (A) for presenting holographic cues (B) in a mapped environment (C).

Results In total, 564 FOG episodes were observed, the vast majority being trembling (84%). The performance of the FOG prediction algorithm was excellent (0.9<AUC<1) for 7, good (0.8<AUC<0.9) for 7 and fair (0.7<AUC<0.8) for 5 of the 24 participants. Deviant performance was attributable to demonstrably distinct data compared to the training dataset because of 1) dyskinesia of the head (AUCs of 0.63 and 0.68), 2) split-level home environment with many stairs (AUC=0.69), 3) fast walking (1.1m/s) with many short (mean 0.71s) FOG episodes (AUC=0.53). The remaining participant experienced no FOG. The algorithm was cross validated, with 0.89 sensitivity, 0.74 specificity and 0.80 accuracy and proved quite robust against movement and environment feature combinations. The true-positive-rate of FOG predictions before they occur was 56%.

Conclusions Timely automatic holographic cue activation is technologically feasible, with fair to excellent overall performance in 79% of participants. In addition to FOG detection, 56% of FOG episodes can already be accurately predicted before they occur with a computationally efficient algorithm fed with features derived from mixed-reality headset data.

[1]Geerse, Coolen, van Hilten & Roerdink (2022). Front. Neurol. 12:628388
[2]Geerse, Coolen & Roerdink (2020). Sensors 20, 3216. doi: 10.3390/s2011321

Poster № 8

BODY CORE TEMPERATURE ASSESMENT

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Introduction Hospitals use a variety of devices to establish if and to what extent patients have fever. There are strong indications in literature and from daily practice that values provided by devices using infrared thermometry do not reflect body core temperature accurately.

Purpose The study aimed to assess the reliability and validity of three systems in use in Dutch academic hospitals (Braun Thermoscan® PRO 6000 and Genius 3 aiming for the tympanic membrane and Exergen TAT-5000S-RS232 aiming at the temporal artery) (**Fig. 1**).

Methods (1) Two devices of each system were calibrated using a black radiator (Voltcraft IRS 350) (2) differences between systems and rectal temperature clamped at about 38°C after exercise were determined in 12 subjects (3) differences between systems and rectal temperature were determined in 133 patients admitted to the emergency department of Amsterdam UMC.

Figure 1 Systems under investigation

Results Calibration showed that Braun and Genius underestimated radiant temperature by 0.77 ± 0.39°C and 1.84 ± 0.26°C respectively and that the Exergen overestimated radiant temperature (0.90 ± 0.51°C). Rectal temperature averaged 38.1°C after cycling exercise; all thermometers underestimated rectal temperature (0.54 ± 0.27°C Braun, 1.03 ± 0.48°C Genius, 1.14 ± 0.38°C Exergen). In the patients admitted to the emergency department, the ear thermometers underestimated rectal temperature by 0.31 ± 0.37°C (Braun) and 0.46 ± 0.50°C (Genius). If, in line recommendations of Mogensen et al.[1], the threshold for fever in all systems would have been set to 37.5°C instead of 38.0°C, the sensitivity and specificity of the systems for real fever (rectal temperature ≥ 38°C) is respectively 71 and 96% (Braun), 57 and 97% (Genius) and 86 and 90% (Exergen).

Conclusions We conclude that the investigated thermometers are not reliable as devices to measure radiant temperature, cannot be used to assess body core temperature during exercise but may be used as a screening device with 37.5°C as a threshold for fever in emergency care settings.

[1] Mogensen et al. BMC Emerg Med. 2018: 18(1), 51

Poster № 9

EMPLOYING DEEP UNSUPERVISED LEARNING TO PERSONALIZE STROKE REHABILITATION

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Introduction Gait impairments due to a stroke result in a declined quality of life and independence. Designing efficient gait training requires an objective and wholesome assessment of the patient's movement pattern, currently not captured by the available assessment tools.

Purpose This study aimed to investigate the ability of variational autoencoders (VAE) to recognize different gait patterns within both, pathologic and healthy gait.

Methods The 3D lower-limb joint angles of 29 stroke survivors[1] and 42 healthy participants[2] during treadmill walking at preferred speed were used to train a symmetric VAE. A total of 5876 trials served as the input data set of which 35% were separated as the test set. The 1D convolutional VAE, containing 3 convolutional layers, a flatten and dense layer was trained to represent the input data in a structured 3-features latent space.

Results The regional analysis revealed that the gait periods of one participant are located within the same region, apart from the trials of another participant (Figure 1). From the reconstructed latent features it followed that along the spiral structure of the latent space, the peak knee flexion angle and in the hip's sagittal plane amplitude increased.

Also, a change from internally rotated to externally rotated ankle joint angles was observed with an overall increase of transverse plane amplitude in the ankle while the frontal plane amplitude of ankle joint motion declined. The stroke survivors were localized in a region characterized by a higher asymmetry, reduced ankle plantar flexion and knee extension during the late swing.

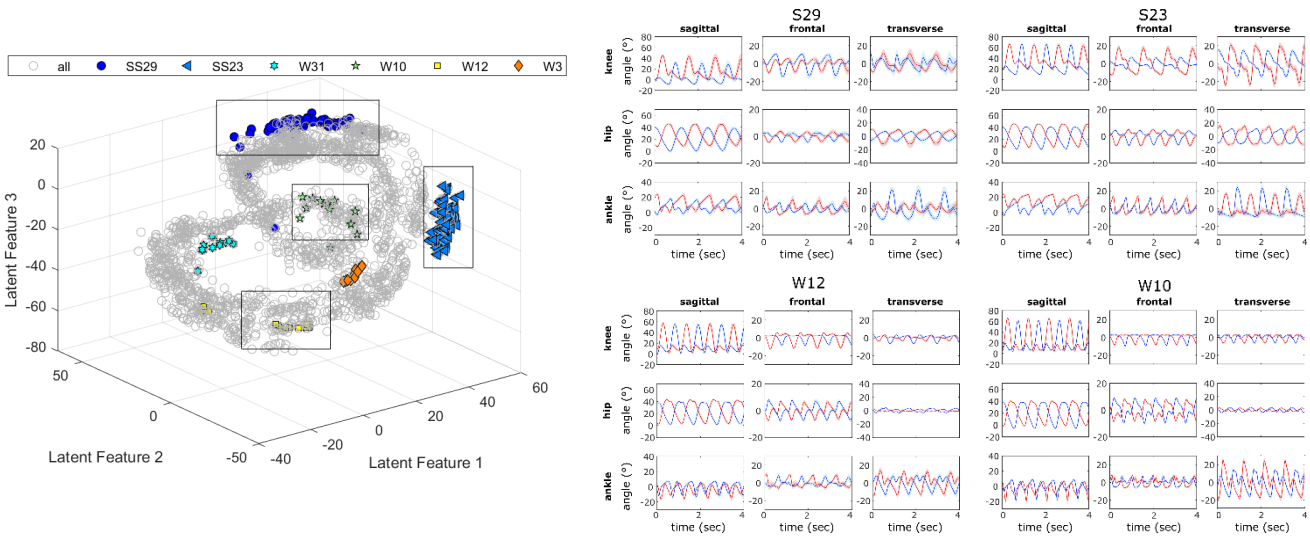

Figure 1. Left: Distribution of the test set within the laten space. Each point represents one gait trial. Right: Lower-limb joint angles of 4 selected participants.

Conclusion The presented results highlight the promising nature of deep unsupervised learning algorithms to assess an individual's movement pattern. By being able to recognize the smallest differences in gait patterns, VAEs could be utilized as an objective and data-driven tool to assess the holistic quality of movement in general and the gait alterations of patients more specifically.

[1]Punt M, et al. J Biomech. 55: 2017.

[2]Fukuchi CA, et al. PeerJ. 6: 2018

Poster № 10

IS CARDIORESPIRATORY FITNESS INDEPENDENTLY ASSOCIATED WITH FATIGUE IN PATIENTS WITH TIA OR MINOR STROKE?

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Introduction: Fatigue is a common complaint among patients with transient ischemic attack (TIA) and minor stroke, and the majority of patients report fatigue as one of their main disabling symptoms. In patients with stroke, decreased cardiorespiratory fitness (CRF) is believed to be related with increased severity of Post Stroke Fatigue (PSF). Patients with TIA and minor stroke also have decreased CRF and physical activity levels, which often do not meet physical activity recommendations and are low compared to the physical activity levels of healthy peers. However, this association between PSF and CRF in patients with TIA and minor stroke is hardly investigated and there is currently no proven effective pharmacological or non-pharmacological treatment for PSF.
Purpose: To determine the association between PSF and CRF in patients with TIA or minor stroke. Subsequently, we investigated if the association was significantly distorted by potential confounders that were also assumed to be associated with PSF and CRF. Based on the literature, we hypothesized that age, gender, physical activity , cognitive functioning, depression, anxiety, stroke type, and co-morbidity could be potential confounders.
Method: A cross-sectional association study was conducted in a total of 119 patients with TIA or minor stroke. PSF was measured by the Fatigue Severity Scale (FSS) and CRF was quantified by maximal exercise capacity (V̇O2max). Depression and anxiety were measured by the Hospital Depression and Anxiety Scale (HADS).
Results: The FSS showed a significant association with V̇O2max (ß=-0.061, SE 0.022, p=0.007). This association was significantly confounded by anxiety (ß=-0.044, SE=0.020, p=0.028) and depression (ß=-0.030, SE=0.022, p=0.177) as measured by the subscales of the HADS. After controlling for HADS depression and HADS anxiety the univariate relationship between V̇O2max and FSS was no longer significant.
Conclusions: The present study suggests that the association between PSF and CRF is weak at best, and is significantly confounded by the factors depression and anxiety in patients with TIA or minor stroke. Future studies should elucidate whether this association is real and influenced by other factors not included in our analyses. Furthermore, anxiety and depression need to be measured and considered as important determinants in CRF trials aimed at influencing PSF.

Poster № 11

ANKLE-FOOT ORTHOSES FOR IMPROVING WALKING IN PEOPLE WITH CALF MUSCLE WEAKNESS DUE TO NEUROMUSCULAR DISORDERS: A COCHRANE SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction
Calf muscle weakness is common in neuromuscular disorders (NMD), causing walking problems like fatigue and falls. To improve walking, ankle-foot-orthoses (AFOs) are often provided. However, an overview of their effectiveness in adults with calf muscle weakness is missing. In order to support decision-making and guide AFO selection, we reviewed current evidence.

Purpose
To review the evidence for effects of AFOs for improving walking in calf muscle weakness due to NMD in comparison to no intervention.

Method
For this Cochrane review, we searched six databases on 20 August 2021 on RCTs and non-randomized studies that examined effects of AFOs in adults with calf muscle weakness caused by NMD compared to no intervention (i.e. shoes-only). We used methodological procedures as described in the Cochrane Handbook. We summarized findings for the primary (objectively measured walking effort) and secondary outcomes, and synthesized effects in meta-analyses grouped where possible according to AFO material. We used the GRADE approach to rate the certainty of the evidence.

Results
We included 9 non-randomized studies (175 participants, sample sizes from 8-37) that examined custom-made or prefabricated AFOs of carbon, polypropylene, silicone, or elastic materials. For carbon AFOs, we found low-quality evidence for a reduction in walking energy cost of 0.86 J/kg/m (95%CI; -1.33 to -0.39; 2 studies), and an increase in walking speed of 0.19 m/s (95%CI; 0.11 to 0.27; 4 studies) compared to shoes-only, and moderate-quality evidence for a beneficial effect on satisfaction while walking. For polypropylene AFOs, (very) low-quality evidence showed no effects on perceived walking effort, walking speed, and balance performance. For silicone AFOs, low-quality evidence showed no effect on perceived walking effort. For elastic AFOs, low-quality evidence showed no effect on walking speed.

Conclusions
Available evidence for AFOs to improve walking in people with calf muscle weakness originates from a few small non-randomized studies of overall low quality with heterogeneity in intervention characteristics and outcome assessment, which highlights the need for well-designed studies. Evidence indicates that carbon AFOs may reduce walking effort, increase walking speed, and enhance satisfaction, while polypropylene, silicone, and elastic AFOs might not improve perceived walking effort, walking speed, and balance.

Poster № 12

IMPROVEMENTS IN WALKING SPEED AND STEP WIDTH VARIABILITY FOLLOWING ANKLE-FOOT ORTHOSIS TREAMTENT ARE RELATED TO INCREASED PERCEIVED STABILITY IN ADULTS WITH NEUROMUSCULAR DISORDERS

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Introduction

Calf muscle weakness is a common symptom in neuromuscular disorders, causing walking problems like instability and falls. To reduce walking problems, ankle-foot-orthoses (AFOs) are often provided. However, the effects of AFOs on gait stability are not well understood, and it is unknown if changes in objective biomechanical gait stability measures capture changes in perceived stability.

Purpose

To examine the relationships between changes in biomechanical measures of gait stability and change in perceived stability following AFO treatment.

Method

We analyzed baseline and follow-up data of 17 subjects with bilateral calf muscle weakness who participated in a RCT, evaluating the effects of specialized orthotic care versus usual orthotic care in neuromuscular disorders. Relationships between changes in biomechanical measures of gait stability and walking speed (obtained with 3D gait analysis), and change in perceived stability (measured on a 10-point numeric rating scale) from shoes only at baseline to walking with an AFO at follow up were tested with Spearman correlations. The following outcomes were obtained: walking speed, margin of stability in medio-lateral and anterior-posterior direction (and its variability), and step length and step width variability.

Results

Changes in walking speed and step width variability were significantly correlated with change in perceived stability during walking (r=0.655 [95%CI: 0.240 to 0.868], p=0.004, and r=-0.505 [95%CI: -0.799 to -0.017], p=0.039, respectively). Changes in variability of the margin of stability in medio-lateral direction and the mean margin of stability in anterior-posterior direction showed trends toward significant relationships with change in perceived stability (r=-0.428, p=0.086, and r=0.433, p=0.083), while the changes in step length variability, mean margin of stability in medio-lateral direction and margin of stability variability in anterior-posterior direction were not related (p≥0562).

Conclusions

We found that improvements in walking speed, and step width variability following AFO treatment were related to increased perceived stability while walking in adults with bilateral calf muscle weakness. To assess the potential of these measures to be used for evaluating the effectiveness of orthotic treatments on gait stability, these relationships should be investigated in multivariate models with a larger sample size.

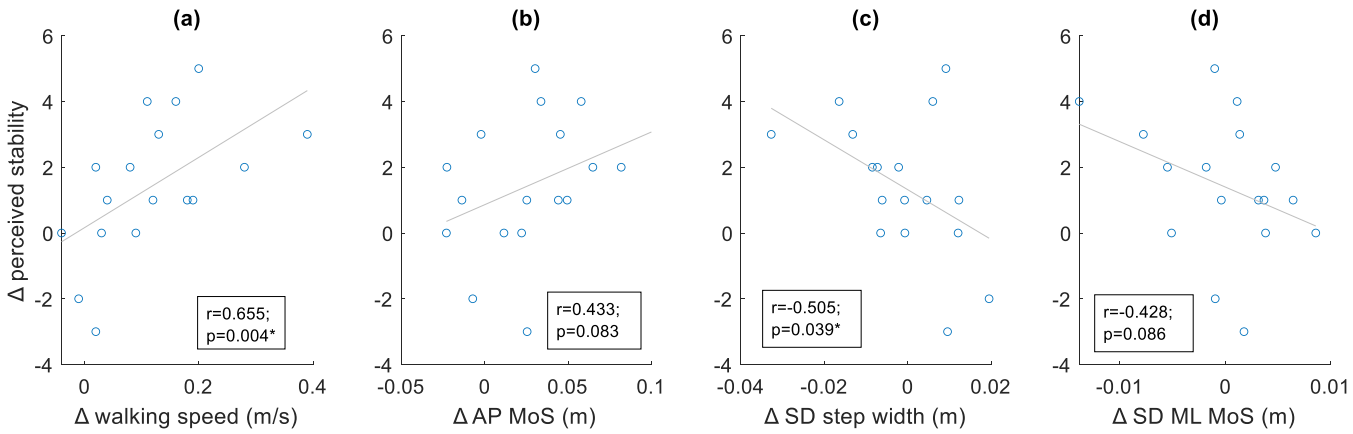

*Figure 1: Correlations with changes in perceived stability for changes in (a) walking speed, (b) margin of stability in anterior-posterior direction, (c) variability of step width, and (d) variability of margin of stability in medio-lateral direction. * denotes significance*

Poster № 13

Amsterdam Movement Sciences

Estimating vastus lateralis muscle volume from a single anatomical cross section using ultrasound

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Introduction: The non-invasive assessment of muscle morphology is valuable in fundamental and clinical research into muscle function. We developed a 3D ultrasound (3D US) technique to reconstruct muscle volume and architecture (Weide et al., 2017 J Vis Exp.129:55943). However, application in large clinical cohort settings is limited due to the time-consuming nature of these measurements.
Purpose: Here, we present an estimation of vastus lateralis muscle volume from a single anatomical cross-sectional area (ACSA) measurement at 50% of muscle length. This would allow muscle volume assessments to be used in large-scale clinical studies.
Methods: Twenty-one healthy volunteers (age range: 22-64) with a heterogenous muscle volume participated in this study. Muscle volume of the vastus lateralis (VL) was assessed by 3D US. Intervals of 10% along the muscle length were plotted against relative ACSA, and a fourth-order polynomial was applied for each individual (Figure 1A). Interpolation of this curve yielded a constant muscle shape factor to estimate VL volume from muscle length and a single ACSA at 50% of muscle length ($ACSA_{50\%}$, which was in 20/21 subjects the maximum area). A regression model was used to compare equation-derived muscle volumes with 3D US values.
Results: Adding the 10% ACSA intervals resulted in a total VL muscle volume of 533±152 (mean±stdev) cm^3. Estimating VL volume in a heterogenous subset of n=21, using a fourth-order polynomial function (Figure 1A) provided the following equation: VL_{volume} = 0.535 (±0.0667) x $Length_{muscle}$ x $ACSA_{50\%}$. Estimation of VL volume based on this derived equation yielded a mean value of 525±162 cm^3, an absolute difference of 37±27 cm^3 vs. 3D US assessed volume (7.3±5.2% relative difference). According to the regression model, our derived equation explained 91.9% of variance in 3D US scans (Figure 1B). The individual muscle shape factor tended to correlate moderately to muscle volume (R^2=0.168, p=0.07).
Conclusions: These results suggest that multiplying muscle length and $ACSA_{50\%}$ by a muscle shape factor of 0.535 is a good way to estimate vastus lateralis muscle volume. Validation of this method in an independent sample population is in progress.

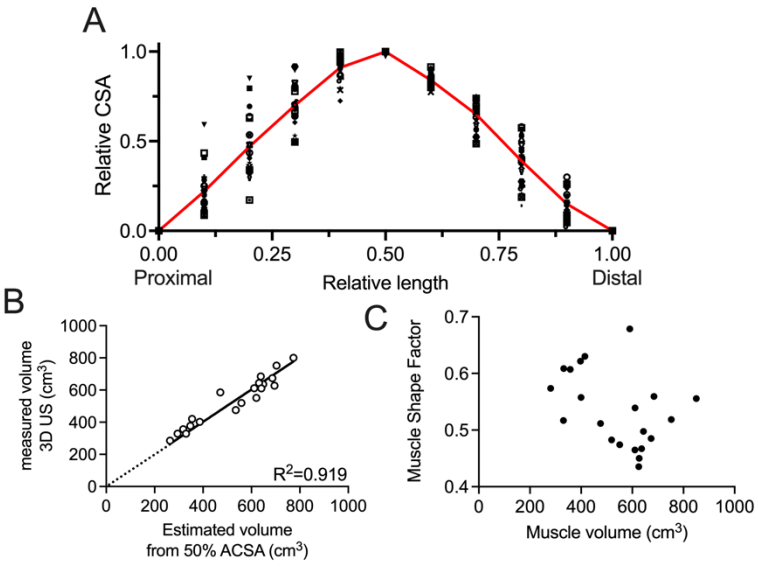

***Figure 1**. **A**: Fourth-order polynomial function. **B**: Estimated muscle volume vs. measured volumes. **C**: Muscle volume vs. muscle shape factor.*

Poster № 14

Title: The effect of nuclear morphology and mechanics in skeletal muscle aging

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Introduction:
Skeletal muscles can produce mechanical forces through contraction of aligned myofibers. However, they may lose their contractile function and mass due to physiological aging, known as sarcopenia. Current literature indicates that sarcopenia affects 10-30% of older adults (age > 60), thereby, highlighting a relationship between sarcopenia and the huge economic burden on the health care system due to an increased morbidity and mortality.
Although, the cellular mechanisms underpinning sarcopenia remains unclear, known is that muscle fibers can sense and respond to mechanical signals through mechanotransduction. Therefore, one hypothesis suggests that intracellular architectural changes or impaired mechano-sensitive pathways within myofibers may contribute to sarcopenia.
Recent evidence demonstrates that the nucleus is a mechano-sensitive organelle capable of transmitting mechanical inputs into biological processes, including changes to chromatin organization and gene expression, through physical links between the cytoskeletal and the nucleus (LINC complex).

Purpose:
The purpose of this project is to test the hypothesis if nuclear abnormalities may disturb mechano-responsiveness in aged myofibers, and thereby contribute to sarcopenia.

Method:
To test our hypothesis, myofibers obtained from mice (age 3 – 18 months) were measured for contraction-induced nuclear deformations. Confocal microscopy was used for visualization of the nucleus and cellular components, and MatLab for data processing to calculate the speed of nuclear displacement (velocity) and the aspect ratio (AR) for nuclear deformation.

Results:
Our measurements revealed significant morphological changes in the myonuclei with aging, as well as redistribution of LINC complex proteins, and a reduction of the nuclear cage formed by the cytoskeletal elements desmin and tubulin at the nuclear periphery. Furthermore, lamin A/C stainings with different epitope binding sides showed changes in lamin A/C accessibility suggesting that modification in the nuclear envelope assembly may have taken place with aging. Finally, our data showed reduced nuclear velocity during and alterations in nuclear responsiveness during contraction with aging.

Conclusions:
Our results suggest that nuclear morphology, lamin A/C accessibility and perinuclear cytoskeletal organization changes with aging in skeletal myofibers, which may influence nuclear responsiveness during muscle contraction. Future work will quantify the mechanical characteristics of aged nuclei through nano-indentation and measure transcriptional activity through mRNA visualization.

Poster № 15

THE (COST-)EFFECTIVENESS OF AN IMPLEMENTED FALL PREVENTION INTERVENTION ON FALLS AND FALL-RELATED INJURIES AMONG COMMUNITY-DWELLING OLDER ADULTS WITH AN INCREASED RISK OF FALLS: PROTOCOL FOR THE 'IN BALANCE' RANDOMIZED CONTROLLED TRIAL

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Introduction: Falls and fall-related injuries among older adults are a serious threat to their quality of life and result in high societal costs.

Purpose: In this study, we will investigate the effectiveness and cost-effectiveness of In Balance, a fourteen-week, low-cost group fall prevention intervention, that is already widely implemented in the Netherlands for community-dwelling non- and pre-frail older adults with an increased fall risk. We expect the In Balance intervention to be (cost-)effective in comparison with standard care in reducing the amount of falls and fall-related injuries in non- and pre-frail older adults.

Methods: This study is a single-blinded, multicenter randomized controlled trial. The target sample will consist of 256 community-dwelling non-frail and pre-frail adults of 65 years or older with an increased risk of falls. The intervention group receives the In Balance intervention as it is currently widely implemented in Dutch healthcare, which includes an educational component and physical exercises. The physical exercises are based on Tai Chi principles and focus on balance and strength. The control group receives general written physical activity recommendations. Primary outcomes are the number of falls and fall-related injuries over 12 months follow-up. Secondary outcomes consist of physical performance measures, physical activity, confidence during walking, health status, quality of life, process measures and societal costs. Mixed model analyses will be conducted for both primary and secondary outcomes and will be stratified for non-frail and pre-frail adults.

Results: No results can be presented since this is an overview of a study protocol.

Conclusions: This trial will provide insight into the clinical and societal impact of a widely used Dutch fall prevention intervention and will have major benefits for older adults, society and health insurance companies. In addition, results of this study will inform healthcare professionals and policy makers about timely and (cost-)effective prevention of falls in older adults.

Poster № 16

PHYSICAL ACTIVITY AS A RISK OR PROTECTIVE FACTOR FOR FALLS AND FALL-RELATED FRACTURES IN NON-FRAIL AND FRAIL OLDER ADULTS: A LONGITUDINAL STUDY

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Introduction: Physical activity may be both a risk and protective factor for falls and fall-related fractures. Despite its positive effects on muscle and bone health, physical activity also increases exposure to situations where falls and fractures occur. This paradox may be explained by frailty status.

Purpose: The aim of this study was to investigate the associations between physical activity and both falls and fractures, and to determine whether frailty modifies the association of physical activity with falls, and fractures.

Methods: Data of 311 community-dwelling participants aged 75 years or older from the Longitudinal Aging Study Amsterdam, who participated in a three-year longitudinal study with five nine-monthly measurements between 2015/2016 and 2018/2019. Their mean age was 81.1 (SD 4.8) years and frailty was present in 30.9% of the participants. Physical activity in minutes per day was objectively assessed with an inertial sensor for seven consecutive days. Falls and fractures were assessed every nine months during an interview over a follow-up period of three years. Frailty was determined at baseline using the frailty index. Associations were estimated using longitudinal logistic regression analyses based on generalized estimating equations.

Results: No association between physical activity and falls was found (OR = 1.00, 95% CI: 0.99–1.00). Fall risk was higher in frail compared to non-frail adults (OR = 2.21, 95% CI: 1.33–3.68), but no effect modification was seen of frailty on the association between physical activity and falls. Also no relation between physical activity and fractures was found (OR = 1.00, 95% CI: 0.99–1.01). Fracture risk was higher in frail compared to non-frail adults (OR = 2.81, 95% CI: 1.02–7.75), but also no effect modification of frailty was present in the association between physical activity and fractures.

Conclusions: No association between physical activity with falls or with fractures was found, and frailty appeared not to be an effect modifier. However, frailty was a risk factor for falls and fractures in this population of older adults. Our findings suggest that physical activity can be safely recommended in non-frail and frail populations for general health benefits, without increasing the risk of falls.

Poster № 17

CONSTANT FORCE MUSCLE STRETCHING INDUCES GREATER ACUTE DEFORMATIONS AND CHANGES IN PASSIVE MECHANICAL PROPERTIES COMPARED TO CONSTANT LENGTH STRETCHING

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Introduction

Stretching is often applied to lengthen shortened muscles in pathological conditions such as joint contractures. Different types of stretching can be used, e.g. constant length (CL) and constant force (CF) stretching. It has been proposed that impulse [1] and maximal strain [2] may be determinants of the potential differences in the effect of stretching.

Purpose

We investigated (i) the acute effects of CL and CF stretching, on acute deformations and changes in passive mechanical properties of medial gastrocnemius muscle (MG) of the rat and (ii) the relationship between these effects and the impulse/maximal strain of stretching.

Methods

Forty-eight hindlimbs from 13 male and 12 female Wistar rats (13 weeks old, respectively 424.6 ± 35.5 and 261.8 ± 15.6 grams) were divided into six groups (n=8 each). Three stretching intensities were applied for each stretch type; the MG was stretched to a length at which the force was 75%, 95%, or 115% of the force found at maximal dorsiflexion and held at either CF or CL for 30 min. The passive muscle was lengthened to the length corresponding to maximal ankle dorsiflexion to assess MG peak force and peak stiffness before and after stretching. Also, muscle belly and tendon length were measured from displacement data and video. Linear mixed models were performed to assess the effects of stretch type/intensity on acute deformations and mechanical changes and to assess the relation of these outcomes with impulse/maximal strain.

Results

CF stretching affected peak force, peak stiffness, muscle belly length, and tendon length more than CL stretching at similar stretch intensities ($p<0.01$). This is in line with previous findings in human subjects [3,4]. Impulse was associated only with the decrease in peak force, while maximal strain was associated with the decrease in peak force, peak stiffness, and the increase in muscle belly length.

Conclusions

We conclude that CF stretching results in greater acute deformations and changes in mechanical properties than CL stretching, which appears to be predominantly dependent on the differences in imposed maximal strain. Low-intensity CF stretching is equally effective as high-intensity CL stretching, while the latter is likely more painful.

References

[1] Fukaya T et al. Sport Sci Health **17(1)**: 953–959 2021.

[2] Kruse A et al. Front Physiol **08** Oct 2021.

[3] Yeh C Y et al. J Electromyogr Kinesiol ***17*(4)**: 453–461 2007.

[4] Cabido C E T et al. **J Strength Cond Res *28*(4)**: 1050–1057 2014

Poster № 18

IN VITRO OPTIMIZATION OF EXTRACELLULAR MATRIX PRODUCTION BY PRIMARY HUMAN MESENCHYMAL CELLS FROM FETAL AND ADULT DERMAL SKIN AND ESCHAR TISSUE

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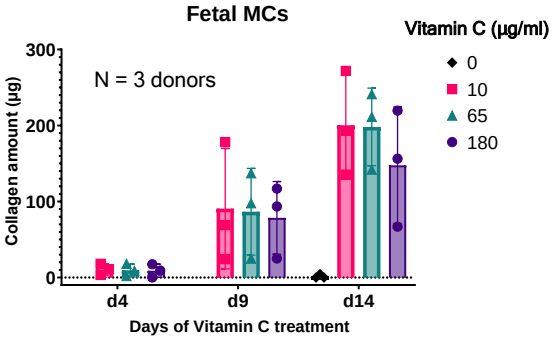
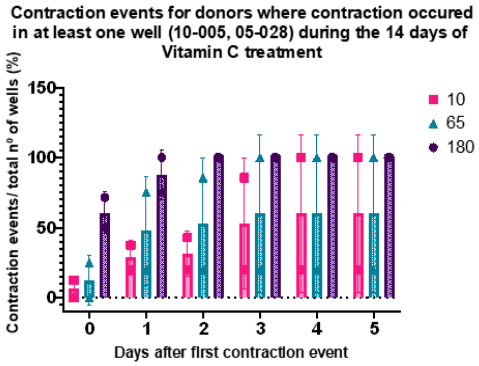
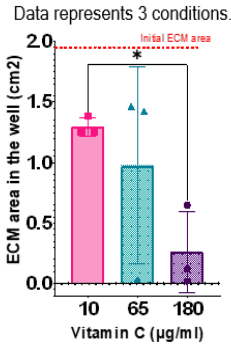
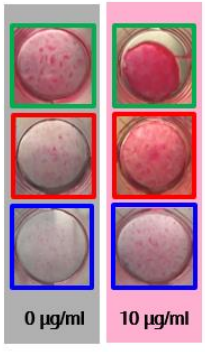
Introduction: In contrast to full-thickness wounds in adults, fetal skin wounds in the early developmental stages heal via tissue regeneration and do not result in scar formation. We hypothesize that the microenvironment created by mesenchymal cells (MCs) during wound healing – including newly produced extracellular matrix (ECM) – directs the outcome. Therefore, the comparison of ECM secreted by fetal *vs* adult skin MCs, as well as healthy *vs* wounded skin MCs may identify key aspects shaping wound healing.
Purpose: This study intended to optimize ECM production by three primary human skin MC populations: fetal, adult dermal, and eschar; and provide an initial insight on their ECM differences.
Method: CnT-PR-ECM medium and media supplemented with various concentrations of vitamin C (from 0 to 180 µg/ml) were tested. MCs were cultured for 2-3 weeks after cells reached confluency. ECM production over time was analyzed at the protein level: macroscopic observation, eosin stained ECM area measured using ImageJ, ECM contraction recording, and soluble/insoluble collagen content measurement using SIRCOL collagen kits.
Results: CnT-prime-medium did not induce ECM formation by dermal MCs contrary to vitamin C supplemented media. No macroscopic differences were found in ECM amount for 10 and 65 µg/ml of vitamin C, but 180 µg/ml showed enhanced contraction and lower collagen amount produced by fetal MCs. Furthermore, both soluble and insoluble collagens increased over time for fetal and eschar MCs, with an earlier appearance of soluble collagen. Fetal MCs showed the highest collagen secretion, whereas dermal MCs produced the lowest.
Conclusions: Since 10 µg/ml of vitamin C better resembles the *in vivo* situation (5 – 15 µg/ml) [1], results support to use this concentration for optimal ECM production by MCs and minimal ECM contraction *in vitro*. Finally, results suggest a higher ECM production by fetal MCs, followed by eschar and, finally, dermal ECM.

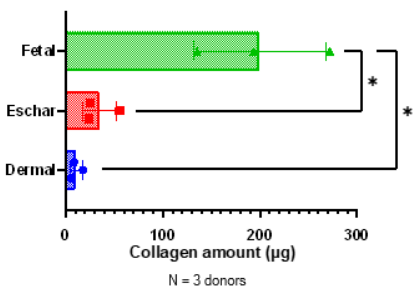
[1] Hagel AF ea J Int Med Res. 2018:46(1):168-174.

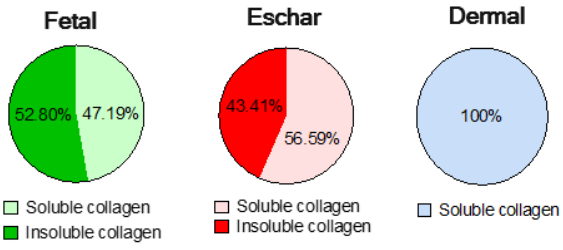












Poster № 19

BRAIN-DERIVED NEUROTROPHIC FACTOR, NEUROFILAMENT LIGHT AND GLIAL FIBRILLARY ACIDIC PROTEIN DO NOT CHANGE IN RESPONSE TO AEROBIC TRAINING IN PEOPLE WITH MS-RELATED FATIGUE – A SECONDARY ANALYSIS OF A RANDOMIZED CONTROLED TRIAL

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Introduction: Neuroinflammation and neurodegeneration are pathological hallmarks of multiple sclerosis (MS). Brain-derived neurotrophic factor (BDNF), neurofilament light (NfL), and glial fibrillary acidic protein (GFAP) are blood-based biomarkers for neurogenesis, axonal damage and astrocyte reactivity, respectively. We hypothesize that exercise has a neuroprotective effect on MS reflected by normalization of BDNF, NfL and GFAP levels.
Purpose: To investigate the neuroprotective effect of aerobic training compared to a control intervention on blood-based biomarkers (i.e. BDNF, NfL, GFAP) in people with MS (pwMS).
Method: In the TREFAMS-AT (Treating Fatigue in Multiple Sclerosis - Aerobic Training) study, 89 pwMS were randomly allocated to either a 16-week aerobic training intervention or a control intervention (3 visits to a MS nurse). In this secondary analysis, serum biomarker concentrations were measured in 55 patients using Simoa technology. Changes in pre- and post-intervention concentrations were compared and between-group differences were assessed using analysis of covariance (ANCOVA). Confounding effects of age, sex, MS-related disability assessed using the Expanded Disability Status Scale (EDSS), MS duration, use of disease-modifying medication, and Body Mass Index were considered.
Results: Blood samples were available for 30 aerobic training and 25 control group participants (mean age 45.6 years, 71% female, median disease duration 8 years, median EDSS score 2.5). Within-group changes in both study groups were small and non-significant, with the exception of BDNF in the control group (median (interquartile range) -2.1 (-4.7; 0)). No between-group differences were found for any biomarker: BDNF (β = 0.11, 95%CI (-3.78 to 4.00)), NfL (β = -0.04, 95%CI (-0.26 to 0.18)), and GFAP (β = -0.01, 95%CI (-0.16 to 0.15)), adjusted for confounders.
Conclusion: Aerobic exercise therapy did not result in significant improvements in the tested neuro-specific blood-based biomarkers in people with MS. No neuroprotective effect of aerobic training was found.

Poster № 20

PERCEIVED STRAIN AND PHYSIOLOGICAL STRAIN OF SOCIETAL PARTICIPATION: TWO DIFFERENT CONSTRUCTS DURING REAL-TIME ASSESSMENT USING DIGITAL HEALTH APPLICATIONS IN PEOPLE WITH MULTIPLE SCLEROSIS

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Introduction: Impaired body functions in people with multiple sclerosis (pwMS) (e.g. muscle strength, cardiorespiratory fitness, balance, fatigue) can increase patient-perceived and physiological strain of societal participation. During exercise, these measures are expected to measure the same construct; whether this is true for societal participation is unknown.

Purpose Examine the relationship between perceived and physiological strain during societal participation in pwMS.

Method: Perceived and physiological strain were measured real-time in 70 pwMS with the Whereabouts smartphone-app and Fitbit, in a community-based setting for 7 consecutive days. Societal participation was divided in 10 participation at location domains and 9 transportation domains. Perceived strain was determined using a 1-10-point scale (1 not strenuous; 10 most strenuous). Physiological strain was operationalized by heart rate reserve (%HRR). Longitudinal relationships between perceived and physiological strain during total societal participation, and for the recreation, leisure and sports domain were examined (mixed model analyses). Type of event (at location or transportation) was added as co-variate, with further adjustments for MS-related fatigue and disease severity.

Results: Median perceived strain, summarized for all societal participation domains, varied between 3 and 6 (range: 1-10), whereas physiological strain varied between 18.5%-33.2%HRR. Perceived strain (outcome) and physiological strain were not associated (β -0.001, 95%CI -0.008; 0.005), with a 7-day longitudinal correlation coefficient of -0.001. Transportation domains were perceived less strenuous (β -0.80, 95%CI -0.92; -0.68). Higher fatigue levels resulted in higher perceived strain (all societal participation domains taken together) (β 0.05, 95%CI 0.02; 0.08).

Conclusion Societal participation results in low-to-moderate perceived and physiological strain. As these measures are unrelated, they should be considered different constructs.

Poster № 21

THE RELATIVE AEROBIC LOAD OF WALKING IN PEOPLE WITH MULTIPLE SCLEROSIS

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Background: In people living with multiple sclerosis (pwMS) mobility impairments often affect walking ability resulting in increased energetic demands during walking. Moreover, pwMS often have a reduced peak aerobic capacity. Together this might result in an increased relative aerobic load of daily walking. The relative aerobic load of walking provides insight into the energetic demand of walking and peak aerobic capacity in pwMS.

Purpose: To examine the energetic demands of walking, relative to the peak aerobic capacity in pwMS.

Method: Prospectively collected data on aerobic capacity from a cardiopulmonary exercise test (CPET), and physiological parameters derived from a 6-minute overground walk test at comfortable walking speed, with mobile gas exchange measurements, were analyzed. The relative aerobic load of walking was determined as energy demand of walking relative to two measures of cardiorespiratory fitness (oxygen uptake at peak and first ventilatory threshold (VT1)).

Results: In total 45 pwMS with an average disease duration of 15 years [IQR: 9-20] and disease severity measured by the Expanded Disability Status scale of 4 [IQR: 3-4.5] were included. PwMS walk at an average relative aerobic load of 89% (range: 57%-153%) and 59% (range: 34%-94%) relative to VT1 and peak aerobic capacity, respectively. During comfortable walking 13 participants used more energy than their VT1. Peak aerobic capacity was low and indicative for improvement in 9 participants. In 11 participants energy demand during walking required improvement and in 6 participants both energy demand of walking and aerobic capacity were indicative for improvement.

Conclusion: PwMS walk at a relative aerobic load close to their VT1. The relative aerobic load can guide clinicians to intervene on the factor(s) causing this high relative aerobic load (i.e. reduced peak aerobic capacity or increased energy demands of walking).

Poster № 22

THE EFFECTS OF AGEING ON MOBILITY IN ADULTS WITH CEREBRAL PALSY – A NARRATIVE REVIEW

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Introduction Cerebral Palsy (CP) is a childhood-onset condition affecting a multitude of developmental domains such as mobility, cognition and motor control. CP affects 1.5-3.4 per 1000 live births (1). It is the most common childhood motor disability and is considered non-progressive in nature, although increases in primary and secondary morbidities are observed throughout life. While the evolution of mobility and motor control is well described in children, and concerted efforts help maintain or improve function, information is lacking regarding the evolution and aetiology of decline from adolescence through adulthood and old age where a decline is often observed around the age of 30 (2) (see **Figure 1**, (3)).

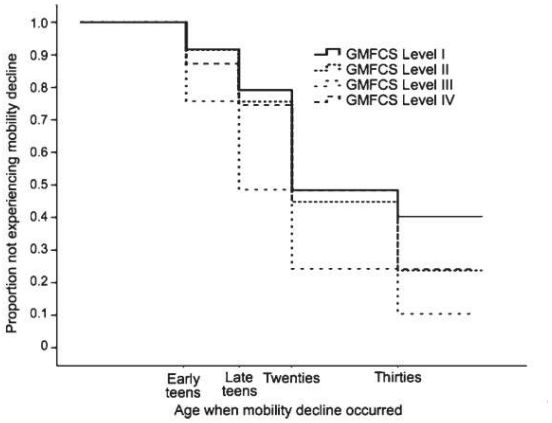

Figure 1 *- Kaplan-Meier plot depicting decline in mobility amongst adults with CP in relation to starting point.*

Purpose The aim of this study is to offer an overview of the latest literature likely explaining identifying factors of the decline in mobility seen with ageing in adults with CP.

Methods An overview was sought through trawling of available literature using Pubmed, Google Scholar and article references with a focus on literature from 2010 and onwards. Key search terms were: "adult(s), cerebral palsy, gait, function. Studies were included if they presented evolution with age in CP patients of self-reported-, Gross Motor Function Classification System-, biomechanical-, cardiovascular-, or motor control outcomes.

Results/findings 9 articles were found to offer age related results on evolution of mobility. Information was available concerning cardiovascular evolution and differences between the general population and those with CP on motor control. Here, studies indicate accelerated ageing of the cardiovascular system compared to the background population. A larger decline was seen in the population comprised of those with the worst starting point. Information from longitudinal studies is lacking on changes to biomechanics of gait and gross motor function.

Conclusions Longitudinal studies investigating a broad spectrum of movement related measures are lacking amongst adults with CP. Several papers indicate loss of mobility without allowing for causal conclusions due to the observational nature of the studies. Future research should investigate a broader spectrum of factors influencing mobility in adults with CP, using longitudinal cohorts.

1. McIntyre S, Goldsmith S, Webb A, Ehlinger V, Hollung SJ, McConnell K, et al. Global prevalence of cerebral palsy: A systematic analysis. Dev Med Child Neurol. 2022;64(12):1494-506.
2. Opheim A, Jahnsen R, Olsson E, Stanghelle JK. Walking function, pain, and fatigue in adults with cerebral palsy: a 7-year follow-up study. Dev Med Child Neurol. 2009;51(5):381-8.
3. Himuro N, Mishima R, Seshimo T, Morishima T, Kosaki K, Ibe S, et al. Change in mobility function and its causes in adults with cerebral palsy by Gross Motor Function Classification System level: A cross-sectional questionnaire study. NeuroRehabilitation. 2018;42(4):383-90.

Poster № 23

SPRINT AND ENDURANCE PERFORMANCE IN YOUNG ELITE SOCCER PLAYERS AT DIFFERENT PLAYING POSITIONS

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Introduction Soccer players have to perform many consecutive sprints at high speed, requiring a combination of both sprint and endurance abilities. Previous literature in other sports has shown an inverse relationship between sprint and endurance performance, suggesting that optimizing these two physical traits simultaneously is challenging.

Purpose This study investigates the relationship between sprint and endurance performance in soccer players, with respect to individual playing positions and match-specific outcomes.

Methods Twenty-four young elite soccer players at a professional football club (U18 & U21, age = 18.0 ± 1.2, height = 180.0 ± 6.7, weight = 72.9 ± 8.7; mean ± standard deviation) performed a maximal incremental treadmill test with gas exchange analysis to measure their $\dot{V}O2_{max}$, which was normalized to lean body mass$^{2/3}$ to eliminate the influence of body size. In addition, sprinting speed was measured over 20 meters using local position measurement. Linear regression analysis was used to evaluate the association between the sprint performance and normalized $\dot{V}O2_{max}$. Moreover, match-specific performance data was obtained. Differences in sprint and endurance test and match performance outcomes were compared between player positions (forwards (F), attacking midfielders (AM), defending midfielders (DM), backs (B) and central defenders (CD) using one-way ANOVA.

Results No significant association between the average sprint speed and the normalized $\dot{V}O2_{max}$ was found in this player group (R^2 = 0.09; p = 0.11). There were also no significant differences in sprint speed (p>0.32) or normalized $\dot{V}O2_{max}$ (p>0.45) between positions. However, substantial differences were shown within groups. Also, there were match-specific differences in total distance (DM = AM = F > B > CD, p<0.05) and total sprint distance (B = F > DM = CD, p<0.05; B > AM > CD, p<0.05).

Conclusions Although there were differences in match performance outcomes, these were not reflected in the maximal sprint and endurance capacity of the present group of young elite players and no significant relationship between these two physical traits could be found. Maximal sprint and endurance performance values did vary substantially between groups, which suggests that some players may benefit from individualized training. Implications for optimization of training are discussed.

Poster № 24

ABSTRACT

TITLE: HOME-BASED AUGMENTED-REALITY GAIT-AND-BALANCE TRAINING FOR PEOPLE WITH PARKINSON'S DISEASE: A CLINICAL FEASIBILITY STUDY (PRE-REGISTERED REPORT)

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Introduction: Clinical guidelines for Parkinson's disease (PD) stress that, alongside pharmacological treatment, exercise should be given a central role to disease management to improve gait and balance. Adhering to regular exercise remains a challenge in PD. Exergaming has the potential to increase adherence to training through play and personalised programs, both in clinic and at home.
Purpose: Cue X is an augmented-reality (AR) home-based gamified gait-and-balance exercise program specifically designed for people with PD as an extension of supervised physiotherapy. The primary objective of this clinical feasibility study in people with PD is to evaluate the feasibility and potential efficacy of Cue X.
Method: 30 individuals with PD (Hoehn & Yahr stage 2-4) with self-reported gait and/or balance difficulties will participate in this study. The study comprises a 6-week waitlist-controlled AR home-based training program consisting of five gait-and-balance exercises (Figure 1). A movement expert will set and adjust the games difficulty levels on a weekly basis, based on objective and subjective data from the AR headset and participant, respectively. Cue X is prescribed for minimally five days a week for 30 minutes per day. In addition to home-based training, the study comprises three laboratory visits: before the 6-week waitlist period (t0), before the 6-week training period (t1) and after the 6-week training period (t2). The main study parameters to evaluate the potential effect of Cue X are standard clinical gait-and-balance tests and targeted walking-related fall-risk assessment using Interactive Walkway walking-adaptability outcomes. The main study parameters to evaluate the clinical feasibility of Cue X are usability, safety, adherence, and patient-reported experience and outcome measures.
Results: Inclusion has started in December 2022 and is now halfway. Results will be available in summer 2023.
Conclusions: This clinical feasibility trial is the first remotely supervised, home-based AR gait-and-balance intervention for people with PD. The results in terms of clinical feasibility (i.e. usability, safety, adherence) and potential efficacy (gait and balance outcomes) form the basis for future randomized controlled studies on the effectiveness of home-based AR gait-and-balance interventions for people with PD.

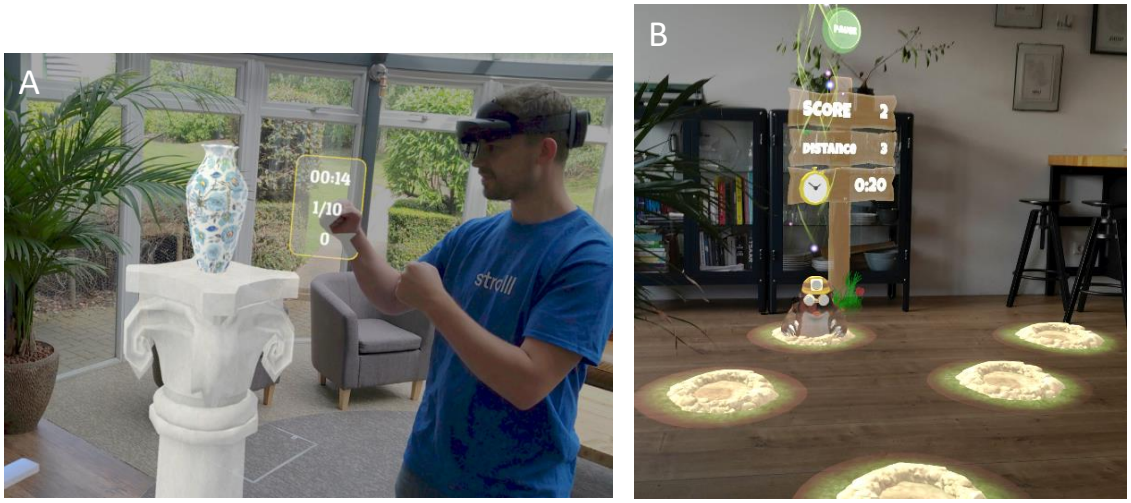

Figure 1. A. Smash B. Mole Patrolll

Poster № 25

CLINICAL EXAMINATION FOR ATHLETES WITH INGUINAL-RELATED GROIN PAIN: INTEREXAMINER RELIABILITY AND PREVALENCE OF POSITIVE TESTS

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Introduction The classification inguinal-related groin pain is based on injury history and clinical examination findings (palpation/resistance test pain).[1] Scientific support for any specific clinical examination test is limited.

Purpose To evaluate the interexaminer reliability of abdominal palpation and resistance tests in athletes with longstanding groin pain, and to identify the prevalence of positive clinical tests in athletes classified with inguinal-related groin pain.

Methods Male athletes (18-40 years) with longstanding groin pain were prospectively recruited between 03-2019 and 10-2020 at a sports medicine hospital. Two examiners performed history taking and standardized clinical examination (including abdominal palpation, scrotal invagination, and abdominal resistance tests) blinded to each other's findings. Interexaminer reliability was calculated using Cohen's Kappa statistic (κ). Examiners classified groin pain using the Doha agreement meeting terminology. A differentiation was made between "defined inguinal-related groin pain" (according to recommended definition criteria[1]), and "likely inguinal-related groin pain" (expert-based application of the Doha agreement classification when not all recommended criteria were present).

Results Forty-four athletes were included (61 symptomatic sides). Interexaminer reliability of inguinal palpation pain provocation tests varied from fair to moderate (κ=0.35–0.49). Reliability of posterior wall structure palpation (firm/soft) was slight (κ=0.01), and posterior wall bulging (yes/no) fair (κ=0.29). Reliability for abdominal resistance tests varied from fair to substantial (κ=0.35–0.72). In athletes classified with defined inguinal-related groin pain, recognizable injury pain on palpation during scrotal invagination when athletes performed a Valsalva maneuver was the most prevalent positive palpation test (79%; **Fig. 1**). Abdominal resistance tests were positive in 21%-49% of these cases.

Conclusion The interexaminer reliability for clinical examination tests used to classify inguinal-related groin pain in athletes varies from slight to substantial. There is no single perfect clinical examination test.

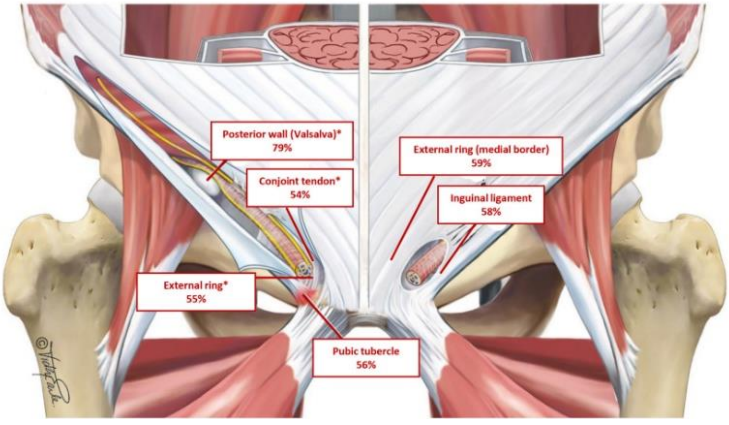

Figure 1. Mean prevalence of palpation pain locations in athletes classified with defined inguinal-related groin pain (examiner A: n=41, examiner B: n=37). *Palpation test performed on scrotal invagination.

[1] Weir et al. *Br J Sports Med.* 2015; 49(12):768–774.

Poster № 26

TYPE 1 DIABETES MELITUS CAUSES DISRUPTED GLUT4 IN SKELETAL MUSCLE DURING EXERCISE

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Introduction

Type 1 Diabetes Melitus (T1DM) is a metabolic autoimmune disease whereby the immune system destroys pancreatic β cells, causing disrupted glucose homeostasis. An important therapy to manage the effects of T1DM is exercise. However, T1DM patients often experience exercise induced hypoglycemia. The cause of these hypoglycemic episodes is unknown. Glucose Transporter 4 (GLUT4) is the primary glucose transporter in skeletal muscle cells and translocates to the sarcolemma upon exercise. However, exercise-induced GLUT4 translocation has not been studied in patients with T1DM.

Purpose

The aim of this study was to access differences in GLUT4 translocation in skeletal muscles of patients with T1DM and healthy controls before and immediately following moderate exercise. We focused on the subcellular localization of GLUT4 with respect to the membrane. We hypothesized that T1DM patients would display blunted translocation of GLUT4 to the sarcolemma during exercise compared to healthy controls

Method

The translocation of GLUT4 was studied by applying an immunohistochemical GLUT4 staining to muscle biopsies of both T1DM (n=8) and control (n=9) participants before and immediately following 30 minutes of moderate-intensity exercise. Widefield microscopy combined with deconvolution was used to assess the co-occurrence between GLUT4 and the cell membrane (Figure 1) .

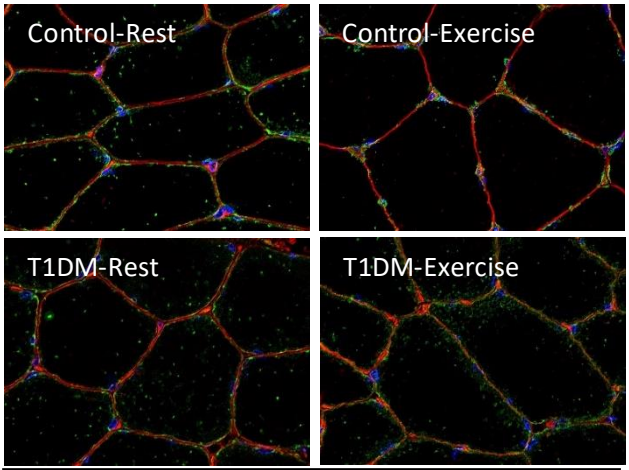

Figure1. Typical examples of GLUT4 stained skeletal muscle. In Green: GLUT4, Red: the Membrane, Blue: Nuclei

Results

Irrespective of exercise, healthy controls displayed greater GLUT4-membrane co-occurrence when compared T1DM patients (p = <0,0001). Moreover, 30 minutes of moderate exercise resulted in an increase in GLUT4-membrane co-occurrence in healthy controls, but not in T1DM patients (interaction effect p = 0.0079) (Figure 2).

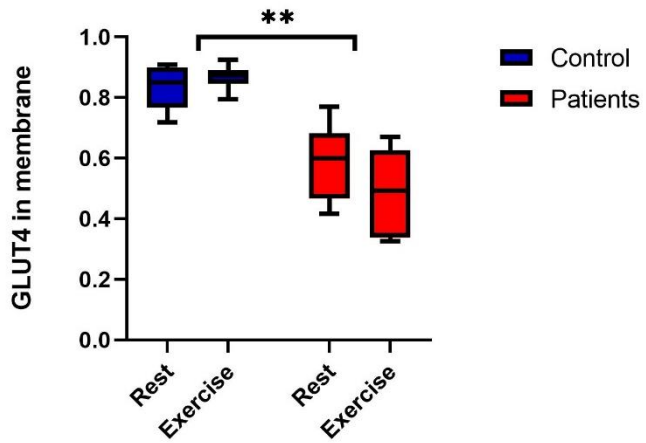

Figure2. Means of the amount of GLUT4 located in the membrane (y-axis) in rest and exercise (x-axis). ** significant interaction effect measured with a 2 way ANOVA

Conclusion

T1DM has an direct impact on the GLUT4 localization in muscle cells. Specifically, irrespective of the performance of exercise, healthy controls had a greater proportion of GLUT4 colocalized with the sarcolemma. Furthermore, exercise failed to stimulate an increase in GLUT4 translocation in T1DM, but not in healthy controls. Future work should explore more of the molecular basis for this effect.

Poster № 27

MUSCLE FIBER CONTRACTILITY IN PATIENTS WITH IMMUNE-MEDIATED NECROTZING MYOPATHY.

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Introduction:

Immune-Mediated Necrotizing Myopathy (IMNM) is an auto-immune disease, in which patients suffer from severe muscle weakness and inflammation, heavily impacting daily activities and quality of life. IMNM is characterized by fast progressive muscle weakness, high creatine kinase levels, muscle fiber necrosis and two myositis specific antibodies (anti-SRP & anti-HMGCR). It is suggested that these antibodies play a complement mediated pathogenic role, leading towards the necrosis and general muscle weakness. However, it is unlikely that the necrosis is the main factor for the muscle weakness, since the proportion of necrotic fibers (compared to non-necrotic fibers) does not correlate with the degree of muscle weakness. Therefore, we hypothesize that the muscle weakness is mainly caused by a loss of contractile function of the non-necrotic fibers.

Purpose:

To determine the involvement of myositis specific antibodies (MSA) in the defective contractile force production in muscle fibers from patients with IMNM.

Method:

Muscle biopsies from 7 anti-SRP+IMNM & 7 anti-HMGCR+ IMNM patients will be compared to healthy controls (N=12). The isolated muscle fibers are skinned, whereby the membranous structures are made permeable, while leaving the sarcomeres (the contractile machinery) intact. The skinned fiber is mounted in an experimental set-up, in which one fiber end is attached to a force transducer and the other to a length motor to adjust sarcomere length (fig.1A). Sarcomere contractility can be studied by exposing the fiber to different levels of exogenous calcium (fig.1B).

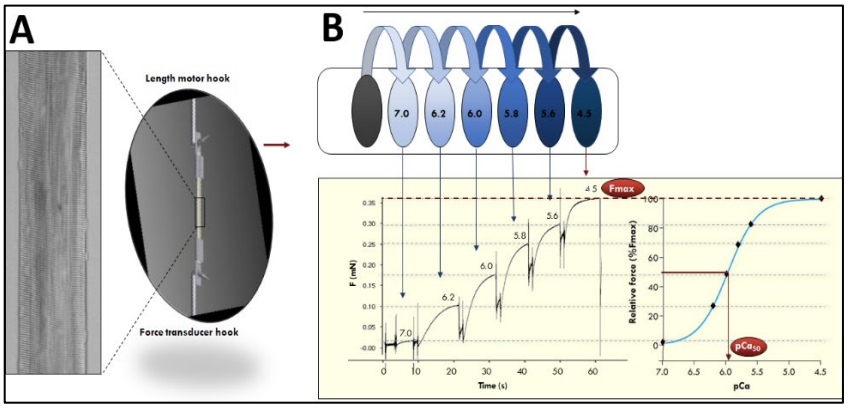

Figure 1 - Single fiber measurement of human skeletal muscle.

Results:

Preliminary data shows a reduced cross-sectional area (CSA) of the muscle fibers in anti-SRP+IMNM patients (0.003±0.001mm^2) compared to healthy controls (0.005±0.002mm^2), $p<0.001$. Furthermore, the maximal force and specific tension (force normalized for CSA) are reduced in anti-SRP+IMNM patients (0.50±0.21mN & 141±37mN/mm^2) compared to healthy controls (1.22±0.45mN & 244±61mN/mm^2), $p<0.001$.

Conclusions:

Skeletal muscle fibers from anti-SRP+IMNM patients exhibit impaired force generating capacity at physiological calcium levels, caused by muscle fiber atrophy as well as sarcomeric dysfunction. The latter may be the result of both lower calcium sensitivity of force and a reduced number of strongly attached cross-bridges during activation.

Poster № 28

ESTIMATING THE MINIMUM CLINICALLY IMPORTANT DIFFERENCE IN FIVE-REPETITION SIT-TO-STAND TEST POST-OPERATIVELY IN PATIENT WITH LUMBAR DEGENERATIVE DISESASE

Anita M. Klukowska[1,2], BMBS, BMedSci; Victor E. Staartjes[1,2,4*], MD, PhD; Manon G. Dol, PA[1]; W. Peter Vandertop[2], MD, PhD; Marc L. Schröder[1], MD, PhD;

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4: Department of Neurosurgery, Clinical Neuroscience Center, University Hospital Zurich, University of Zurich, Zurich, Switzerland

INTRODUCTION: The five-repetition sit-to-stand test (5R-STS) has recently been validated in patients with lumbar degenerative disease (LDD). It can be used to assess disease severity and monitor recovery objectively and quickly. However, the clinically meaningful change of the 5R-STS time is yet unknown.

PURPOSE: The aim of this study is to calculate the minimum clinically important difference (MCID) in 5R-STS after surgery in patients with LDD at 1-yeast post-operative follow-up.

METHODS: Adult patients (>18 years old) with LDD scheduled for surgery were recruited from a Dutch short-stay specialized spinal clinic. Their age, gender, weight, height, body mass index, previous spinal surgery, level of spinal pathology, hernia site, analgesia use, history of pain, smoker status, education level, mood, ability to work and work situation were recorded. The 5R-STS time, Oswestry Disability Index (ODI), Roland-Morris Disability Questionnaire (RMDQ), Visual Analogue Scale (VAS) for back and leg pain, EQ5D Health & Anxiety and EQ5D-VAS were recorded pre-operatively, at 6-weeks and at 1-year post-operatively. Three anchor-based methods were used to establish the MCID value, including average change; minimum detectable change (MDC) and change difference approach. Anchors were responders of VAS back and leg pain, ODI, RMDQ and EQ5D-VAS.

RESULTS: We recruited 134 patients and 103 were included. The mean age was 53.2±14.35 and 51.5% were male. The mean pre-operative 5R-STS time was 13.0±6.1 seconds (s), at 6-week it was 10.4±4.6s and 1-year it was 9.4±3.2s. Across all patient-reported-outcome measures a statistically significant (*p-value <.001*) improvement was identified at 6-week and 1-year post-operatively. Overall, thirteen MCID values were calculated for the 5R-STS. They ranged from -0.8s for VAS Leg Pain using change difference approach to -5.2s for VAS Back Pain responders utilizing the average change approach. The average MCID of 5R-STS according to VAS Back Pain, VAS Leg Pain, ODI, RDMQ and EQ5D-VAS was -4.1s, -3.1s, -3.5s, -4.0s and -3.8s, respectively.

CONCLUSIONS: As expected, the 5R-STS MCID value was dependent on technique and responders. For a patient to experience a noticeable improvement in their functional impairment at 1-year post-operatively according to distribution-based method, their 5R-STS time should decrease by 3.7s (ClinicalTrials.gov Identifier: NCT04660656).

Poster № 29

PREDICTIVE VALUE OF THE FIVE-REPETITION SIT-TO-STAND TEST AFTER LUMBAR SPINE SURGERY

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INTRODUCTION : The five-repetition-sit-to-stand test (5R-STS), has recently been validated in patients with lumbar degenerative disease (LDD). It is unknown, however, whether it can also inform post-operative outcomes.

PURPOSE: We aimed to determine whether pre-operative objective functional impairment (OFI) measured by 5R-STS could predict outcomes post-lumbar spine surgery at 12-months.

METHODS: Adult patients (>18 years of age) with LDD scheduled for surgery were recruited from a Dutch short-stay spinal clinic. Their age, gender, weight, height, body mass index, previous spinal surgery, level of pathology, hernia site, analgesia use, history of pain, smoking status, education level and work situation were recorded. The 5R-STS time and Patient-Reported-Outcome-Measures (PROMs): Oswestry Disability Index (ODI), Roland-Morris Disability Questionnaire (RMDQ), Visual Analogue Scale (VAS) for back and leg pain, EQ5D Health & Anxiety, EQ5D-VAS, and ability to work were recorded pre-operatively and at 12-month post-operatively A 5R-STS time cut-off of ≥10.5s was used to determine OFI. Mann-Whitney test and Chi-square test were employed to determine significant differences in post-operative outcomes between groups stratified by presence of pre-operative OFI.

RESULTS: We recruited 134 patients, and 103 patients were included. The mean age was 53.2±14.35, 48.5% were female and 46.6% were unable to work. The mean 5R-STS time was 13.0±6.1. Pre-operatively, 53 patients had OFI. Patients with OFI had significantly higher ODI, RMDQ, VAS back pain, VAS leg pain, EQ5D-VAS score (*p<0.001)* and experienced more anxiety & depression as measured by EQ5D VAS Anxiety & Depression (p=0.024). At 12-month post-operatively, patients with OFI experienced greater mean change in PROMs than patients without pre-operative OFI (*p<0.001)* except for VAS leg pain (p=0.223). There were no significant differences in mean post-operative PROM's score between groups. Nearly 74% of cohort were able to fully work post-surgery.

CONCLUSIONS: Although there were no significant differences in mean post-operative scores between groups at 12-month follow-up, patients with pre-operative OFI experienced a greater improvement in PROM scores compared to no-OFI group. It can be concluded that presence of OFI based on 5R-STS time does not decrease patient's likelihood of experiencing satisfactory post-operative outcomes. The 5R-STS in itself cannot predict how a patient with LDD will respond to surgery at 12-month follow up. (ClinicalTrials.gov Identifier: NCT04660656)

Poster № 30

POTENTIAL NEUROIMMUNE PROTECTIVE EFFECTS OF PRIOR REGULAR EXERCISE FOLLOWING EXPERIMENTALLY-INDUCED TRAUMATIC NEUROPATHY: A SYSTEMATIC REVIEW WITH META-ANALYSIS

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Introduction: Animal studies show that neuropathy is associated with complex neuroimmune responses (such as neuropeptides, cytokines, gene expression and hormones involved in interactions between the immune and nervous system), which are associated with increased intensity and persistence of neuropathic pain [1-2]. Routine exercise has the potential to mitigate complications of future nerve damage and persistence of pain through neuroimmune regulation by promoting an anti-inflammatory state.
Purpose: This systematic review aimed to explore the effect of prior exercise on neuroimmune responses, and other physiological and behavioural reactions following experimentally-induced traumatic peripheral neuropathy in animals.
Methods: Systematic review and meta-analyses were performed using a random effects model. Three electronic databases were searched from inception to July 2022. All controlled animal studies assessing the influence of an active exercise program prior to experimentally-induced traumatic peripheral neuropathy compared to a non-exercise control group on neuroimmune, physiological and behavioural outcomes were selected (Figure 1).
Results: The search identified 17,431 records. After screening, 11 articles were included. For neuroimmune outcomes, 72 comparisons at different anatomical locations were identified. Meta-analyses showed that prior exercise significantly reduced levels of IL-1β (SMD: -1.06, 95% CI: -1.99 to -0.13, n=40), but not iNOS (SMD: -0.71 95% CI: -1.66 to 0.25, n=82). For neuroimmune outcomes only measured once, vote counting revealed reductions in 23 pro-inflammatory and increases in 6 anti-inflammatory neuroimmune outcomes. For physiological outcomes, meta-analyses revealed that prior exercise improved one out of six nerve morphometric related outcomes (G-ratio; SMD: 1.95, 95%CI: 0.77 to 3.12, n=20) and one out of two muscle morphometric outcomes (muscle fibre cross-sectional area; SMD: 0.91, 95%CI: 0.27 to 1.54, n=48). For behavioural outcomes, no overall effect was seen for mechanical allodynia and sciatic function index. Post hoc subgroup analysis suggests that timing of outcome measurement may influence the effect or prior exercise on mechanical allodynia. Risk of bias was unclear in most studies, as the design and conduct of the included experiments were poorly reported.
Conclusions: Preventative exercise may have potential neuroprotective and immunoregulatory effects in animals with experimentally-induced traumatic neuropathy compared to non-exercise, but more research in this field is urgently needed.

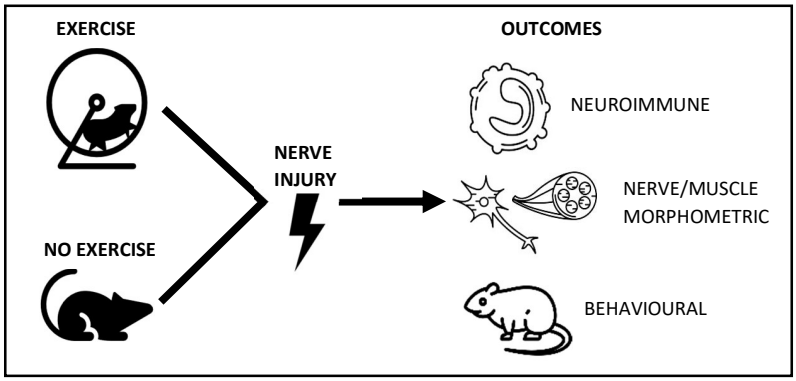

Figure 1. Overview of included study designs

[1]Ellis A. ea Br. J. Anaesth. 2013
[2]Yu X. ea *Nat Commun*. 2020

Poster № 31

CHANGES IN BODY SATISFACTION DURING AND AFTER A 5-MONTH HANDCYCLE TRAINING PERIOD AND ASSOCIATIONS WITH PHYSICAL CAPACITY AND BODY COMPOSITION

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Introduction: In individuals with a physical impairment, body image disturbances are frequently described. Changes in body function and physical appearance, pain and discomfort, weight gain as well as changes in psychological factors, such as self-efficacy and illness cognitions, as a consequence of having a physical impairment, have all shown to be associated with body image disturbances. Several studies highlighted the positive effects of exercise or physical activity on body image. Unfortunately, it is unknown whether these improvements in body satisfaction are preserved after the exercise intervention.
Purpose: To examine: (1) changes in body satisfaction during five months of handcycle training and one year after the training period; (2) whether longitudinal changes are dependent on sex, (un)healthy waist circumference and severity of the impairment; (3) associations between changes in physical capacity or body composition, and body satisfaction.
Methods: Individuals (N=143) with health conditions such as spinal cord injury (60%) were included. Participants filled out the Adult Body Satisfaction Questionnaire at four time points: start of the training (T1), after the training period (T2) and four months (T3) and one year follow-up (T4). The questionnaire has two subscales: functional satisfaction (range: -3 to 3) and appearance satisfaction (range: -3 to 3). At T1 and T2, waist circumference was measured and an upper-body graded exercise test was performed to measure physical capacity. Multilevel regression analyses were used to investigate longitudinal changes, interaction effects and associations.
Results: Functional satisfaction significantly increased during the training period (0.69±1.18 to 1.48±0.92) and significantly decreased during follow-up (to 0.79±1.49 at T4). Appearance satisfaction significantly increased during the training period (0.57±1.70 to 1.18±1.57) and significantly decreased during follow-up (to 0.32±1.70 at T4). Individuals with more severe impairments showed a significantly larger decrease during follow-up than individuals with less severe impairments. Improvements in physical capacity (+21%) and waist circumference (-4%) were significantly associated with improvements in both subscales of body satisfaction.
Conclusions: Body satisfaction significantly increased during the training period, but significantly decreased during follow-up. Additional efforts might be necessary to keep individuals engaged in physical activity and exercise on the long term.

Poster № 32

METABOLIC LOAD DURING MORNING CARE AND ACTIVE BED EXERCISES IN CRITICALLY ILL PATIENTS; AN EXPLORATIVE STUDY

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Introduction

For the benefit of physical recovery, starting active rehabilitation at an early stage is advocated for critically ill patients who are awake after sedation. However, as exercise capacity is often limited, daily nursing care activities and active bed exercises can be very demanding to perform. To avoid overexertion information on physical demand, i.e. metabolic load, of daily care and active exercises is warranted.

Purpose

The purpose of this explorative study was to assess the metabolic load of morning care and active bed exercise in mechanically ventilated critically ill patients.

Methods

An observational study was executed on a university hospital intensive care unit (ICU). Metabolic load was evaluated using gas exchange variables in mechanically ventilated (≥48hrs) critically ill patients during routine morning care and active bed exercises. We determined the absolute oxygen consumption (in mLO_2), defined as VO_2 attributable to the activity (i.e. VO_2 morning care/bed exercises – VO_2 rest), and the relative VO_2 in mL per kilogram bodyweight, per minute (mL/kg/min). Additional outcomes; perceived exertion and the highest VO_2 values achieved during the activity. Changes in VO_2 were tested using paired tests.

Results

Twenty-one patients were included with a mean (SD) age of 59 (12). Median (IQR) duration of morning care and active bed exercises was 26 min (21-29) and 7 min (5-12) respectively. Absolute VO_2 of morning care was significantly higher compared to active bed exercises (n=10, p=0,009)(**Fig. 1**). Median (IQR) relative VO_2 was 2,9 (2,6-3,8) mL/kg/min during rest, 3,1 (2,8-3,7) during morning care and 3,2 (2,7-4) during active bed exercises. Median (IQR) highest VO_2 values were 4,9 (4,2-5,7) mL/kg/min during morning care and 3,7 (3,2-5,3) during active bed exercises. Median (IQR) perceived exertion on the 6-20 Borg-scale was 12 (10,3-14,5) during morning care (n=8) and 13,5 (11-15) during active bed exercises (n=6).

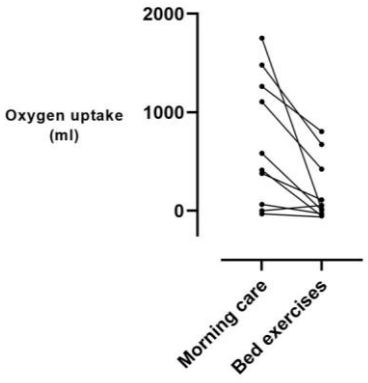

***Figure 1**. (Absolute) VO_2 attributable to the activity*

Conclusion

Absolute VO_2 in mechanically ventilated patients can be higher during morning care as compared to active bed exercises due to the longer activity duration. ICU clinicians should be aware that daily care activities may cause intervals of relatively high metabolic load and high ratings of perceived exertion.

Poster № 33

SELF-MONITORING OF PHYSICAL ACTIVITY AND PROTEIN INTAKE AFTER HOSPITAL DISCHARGE IN SURGICAL ONCOLOGICAL PATIENTS: A FEASIBILITY STUDY

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Introduction

Improving physical activity, especially in combination with optimizing protein intake, after surgery has a potential positive effect on recovery of physical functioning in patients after oncological surgery. We developed the hybrid OPRAH (Optimal Physical Recovery After Hospitalization) intervention consisting of coaching by an professional in combination with an accelerometer and smartphone application (Atris app) that enables self-monitoring of physical activity and protein intake, after hospital discharge.

Purpose

To determine the feasibility of the OPRAH intervention and the feasibility and acceptability of the study design as prelude to a randomized controlled trial in patients after gastro-intestinal or lung cancer surgery.

Method

A non-randomised one-armed intervention study was conducted in 32 patients. The intervention consisted of the use of the Atris app and remote coaching by a physiotherapist and dietician during 3 months after hospital discharge. Measurements included the PROMIS-physical functioning, physical activity (ActivPAL), bioelectrical impedance analysis, 48-h dietary recall and physical performance tests. Feasibility criteria regarding the intervention and the study procedures were set *a priori*.

Results

The Atris app was considered usable with a mean System Usability Score of 73%. Of all participants, 95% would recommend others to use the Atris app. Adherence to the intervention was good, as the movement sensor was worn on average 91% of the time. Protein intake was not yet sufficiently tracked (59%). Patients indicated that the number of options was too minimal when entering protein intake, making it less motivating to fill it in. The participation rate was 69%. The completion rate of the follow-up measurements was 75%. Of all outcomes, more than 80% was complete, except for the ActivPAL data (68% complete). This was due to lost and non-working sensors. No (S)AE's have been reported.

Conclusion

Self-monitoring of physical activity and protein intake using the Atris app in patients after oncological surgery is feasible, however we made adjustments to the Atris app and added several nutritional products. In addition, we designed a flyer with additional information about the importance of protein. The study procedures were considered feasible and do not need adjustments. However, consideration will be made to reduce the number of missing data from te ActivPals.

Poster № 34

A PROTOCOL TO STUDY THE INTERACTION BETWEEN NOCICEPTION AND SPINE STABILITY ON TRUNK NEUROMUSCULAR CONTROL IN RATS

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Introduction: Low back pain (LBP) patients exhibit a large spectrum of changes in motor behaviour, but it remains unclear why both increases and decreases in low-back muscle activity are observed. This may be explained by the presence of nociception in combination with an instable spine. To compensate for the latter, increased activity of low-back muscles is required[1]. Conversely, nociception is expected to decrease muscle activity level[2]. The above defines a neural dilemma, wherefore it is unknown if the effect of nociception on muscle activity differs if spine stability is also compromised.

Purpose: To present the protocol of a controlled exploratory study aimed at investigating the effects of nociception and spine instability, as well as their interaction on neuromuscular control of low-back muscles in the rat.

Method: Intramuscular electromyography (EMG) of multifidus and longissimus muscles at spinal levels L4 and L5 will be collected during locomotion. The experimental group (n=10) will undergo intervertebral disc (IVD) lesion surgery to induce lumbar spine instability[3], and receive hypertonic saline injection into the multifidus muscle to cause transient nociception (Fig. 1). The control group (n=5) will undergo a sham surgery for IVD lesion and receive sham saline injections. Changes in EMG pattern, amplitude, burst duration and timing will be assessed.

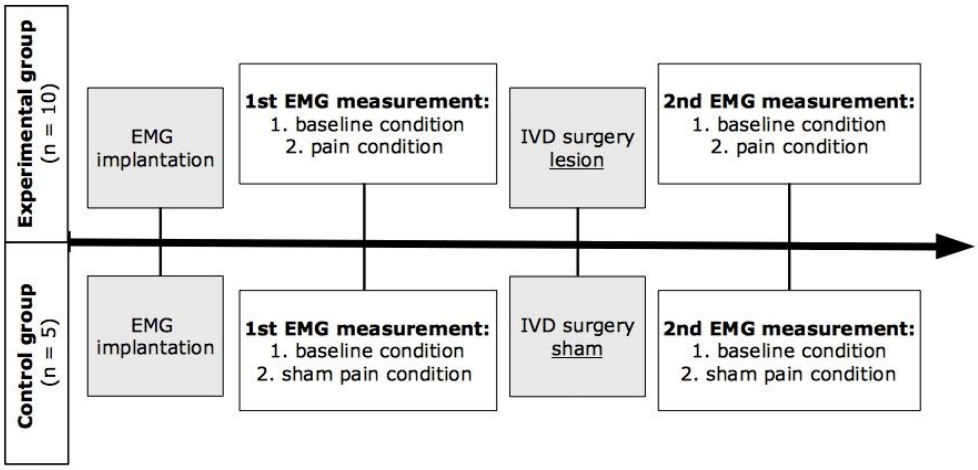

Figure 1**:** Overview of the experimental protocol.

Results: We hypothesize that spine instability will lead to increased and nociception to decreased activity levels of low-back muscles. For the interaction effect, two results may be expected. (a) Nociception alters EMG similarly in both conditions of spine stability or (b) the effect of nociception differs between stable and unstable spines. If the latter is found, this would suggest that the effect of nociception is not predictable and may depend on other factors, such as spine stability.

Conclusions: This study is considered a first step towards understanding the mechanisms underlying the variable changes of trunk muscle activity in LBP.

[1] Panjabi, 1992, *J Spinal Disord.* 5, 383–389.
[2] Graven-Nielsen et al., 1997, *Electroencephalogr Clin Neurophysiol.* 105, 156–164.
[3] Maas et al., 2018, *J Biomech*. 70, 228–234.

Poster № 35

SILIBININ ATTENUATES EXPERIMENTAL PERIODONTITIS BY DOWN-REGULATION OF INFLAMMATION AND OXIDATIVE STRESS

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Introduction: Periodontitis is an oral microbiota-induced inflammatory disease, in which inflammation and oxidative stress play a critical role. Silibinin (SB), a Silybum Marianum-derived compound, exhibits strong anti-inflammatory and antioxidative properties.

Purpose： To reveal whether SB can attenuate inflammatory and oxidative reactions in periodontitis so as to prevent periodontal soft and hard tissue destructions.

Methods: We adopted an in vivo rat ligature-induced periodontitis model and an in vitro lipopolysaccharide (LPS)-stimulated human periodontal ligament cells (hPDLCs) model to evaluate the protective effects of SB.

Results: In the *in vivo* model, SB reduced alveolar bone loss and apoptosis of PDLCs in the periodontal tissue. SB also maintained the expression of nuclear factor-E2-related factor 2 (Nrf2), a key regulator of cellular resistance to oxidative stress, and attenuated lipid, protein and DNA oxidative damages in the periodontal lesion area. Meanwhile, in the *in vitro* model, SB administration reduced the production of intracellular reactive oxidative species (ROS). Furthermore, SB has exerted a strong anti-inflammatory property in both *in vivo* and *in vitro* models by inhibiting the expression of inflammatory mediators including nuclear factor-κB (NF-κB) as well as Nucleotide binding oligomerization domain (Nod)-like receptor family pyrin domain-containing 3 (NLRP3) and downregulating the levels of pro-inflammatory cytokines.

Conclusion: Our findings, for the first time, demonstrates that SB exhibited the anti-inflammatory and antioxidative properties against periodontitis by downregulating the expression of NF-κB, NLRP3, and upregulating the expression of Nrf2, suggesting a promising potential clinical application of SB in periodontitis.

Poster № 36

BONE MARROW EDEMA ON DUAL-ENERGY CT IN PATIENTS WITH DIABETES MELLITUS AND SUSPECTED CHARCOT NEURO-OSTEOARTHOPATHY

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Introduction Charcot neuro-osteoarthropathy is a severe complication of diabetic peripheral polyneuropathy. In this condition the joints and bones of the midfoot can collapse due to a non-inflammatory process possibly leading to a rocker bottom foot. Early diagnosis is important to enable rapid immobilization of the foot and prevent major foot deformity. Dual-energy CT (DECT) could aid and accelerate the diagnostic process of Charcot.

Purpose This study aims to quantitatively assess the feasibility of bone marrow edema (BME) detection on virtual non-calcium (VNCa) images calculated from DECT in patients with diabetes mellitus and suspected Charcot neuro-osteoarthropathy.

Methods Patients with diabetes mellitus and suspected Charcot neuro-osteoarthropathy who underwent DECT (80kVp/Sn150kVp) were retrospectively included. Two observers independently measured CT values in Hounsfield Units (HU) on VNCa images using circular regions of interest in five locations in the midfoot (cuneiform bones, cuboid bone and navicular bone) and in the calcaneal bone of the contralateral foot or (if only one foot was available) the ipsilateral foot. The patients were divided into two clinical groups, Charcot and no-Charcot, based on the final clinical diagnosis. Intraclass correlation coefficients (ICCs) were calculated to test the observer agreement.

Results A total of 32 patients with suspected Charcot were included. Of these patients, 11 had active Charcot. The mean CT value in the midfoot was significantly higher in the Charcot group (-55.6 ± 18.7 HU) compared to the no-Charcot group (-94.4 ± 23.5 HU; $p < 0.001$). In the Charcot group, the difference in CT value between midfoot and the calcaneus was statistically significant ($p = 0.003$); this was not the case in the no-Charcot group ($p = 0.357$). The overall observer agreement was good for the midfoot (ICC = 0.804) and moderate for the calcaneus (ICC = 0.712). With a cutoff value of -87.6 HU, sensitivity was 100.0%, specificity was 71.4%, PPV was 64.7% and NPV was 100.0%.

Conclusions The detection of BME on VNCa images calculated from DECT has a potential value in patients with diabetes mellitus and suspected Charcot neuro-osteoarthropathy.

Poster № 37

ADJUST: A STIFFNESS ADJUSTABLE ANKLE-FOOT-ORTHOSIS FOR EFFICIENT HUMAN-IN-THE-LOOP ORTHOSIS SELECTION

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Introduction Walking problems, including increased metabolic energy cost[1], diminished speed[1] and falls[2,3] are a major cause of mobility limitations in people with muscle weakness due to neuromuscular disorders[4]. Treatment with ankle-foot-orthoses (AFOs) is an important therapy to augment walking. We have previously demonstrated that the effectiveness of AFOs to augment walking can be greatly improved, when the stiffness is individually optimized[5]. Currently, this is done by performing a series of walk tests and gait analyses with different stiffness settings changed manually. This is very laborious and time consuming (approximately 8 hours for testing and analysing) and also burdensome for patients. To make the optimization procedure faster, our goal was to design and build an untethered wearable AFO of which the stiffness can be continuously altered in real-time.

Purpose To design, build and test a novel AFO of which the stiffness can be changed during walking.

Methods A set of requirements was made with the following four being the most important:

1. Variable stiffness range needs to be changed between 1 - 7 Nm/deg
2. The weight of the orthosis connected to the patient must be under 750g (shoes excluded)
3. It must be possible to change the stiffness during walking
4. Allow different sizes of patients, e.g. length, shoe size, weight, shank length, to fit the device

Results The device we developed, called ADJUST-AFO (Figure 1) uses a variable spring mechanism with a cam-based transmission. It can change the bending stiffness of the AFO in real time during walking, by moving a small slider, changing the active spring length.

Conclusions We developed the ADJUST-AFO, which stiffness can be changed between 1 and 7 Nm/degree while walking, allowing us to continuously measure the optimisation parameter, walking energy cost, while changing stiffness levels. This device holds the promise to fasten AFO optimization in patients with neuromuscular disorders, thereby improving orthotic care by individually maximize treatment outcomes. In the near future, we will start a series of feasibility and validation tests in healthy subjects and patients. With our new protocol we expect to reduce the total optimisation time from 8 to 1.5 hours.

Fig 1: ADJUST device

[1]Brehm ea Arch Phys Med Rehabil. 2006;87:136-140
[2]Pieterse ea J Neurol Sci. 2006;251:87-90
[3]Bickerstaffe ea J Rehabil Med. 2010;42(10):908-915
[4]Demir NPTS, Suzuki T(Ed.) InTech, London
[5]Waterval ea TNSRE 2020.3018786

Poster № 38

BALANCING ENERGY EXPENDITURE AND ENERGY INTAKE IN PEOPLE WITH NEUROMUSCULAR DISEASES; NEXT STEPS TOWARDS INDIVIDUALIZED NUTRITIONAL ADVICE

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Introduction: Many people with neuromuscular diseases (NMD) are overweight and have difficulties to lose their excessive weight, resulting in co-morbidities that negatively impact daily functioning and quality of life. Due to symptoms like muscle weakness and fatigue they are prone to a sedentary lifestyle [1], resulting in a disturbed balance of energy expenditure and intake. The underlying patterns of this disturbed energy balance in the heterogeneous NMD population are still unknown.

Purpose: To compare resting and physical activity energy expenditure, energy intake and body composition between overweight and non-overweight people with slowly progressive NMD.

Method: We will include 20 overweight adults with NMD (BMI ≥ 25 kg/m^2) and 20 adults with NMD without overweight (BMI: 18-25 kg/m^2). Resting energy expenditure will be measured using a ventilated hood system (indirect calorimetry). Physical activity energy expenditure will be estimated based on 3-day accelerometer and heart rate (HR) monitoring, using the linear relationship between HR and energy expenditure (EE) [2]. For each participant the HR and EE (i.e. oxygen consumption) are measured during incremental maximal exercise testing on a bicycle ergometer, to establish the HR-EE relationship. Energy intake will be recorded with a 3-day weighed food diary, which will be cross checked by an experienced dietitian. Body composition will be measured by air displacement plethysmography (BODPOD) and bioelectrical impedance analysis. Differences in energy expenditure, energy intake and body composition between both groups will be tested with independent t-tests or Mann Whitney U-tests.

Conclusions: The results of this research may increase the knowledge about the disturbed energy balance in overweight people with NMD and provide directions for next steps towards individualized nutritional advice in this population.

Acknowledgements: This project is made possible with funding from the AMS 2022 call.

1. McDonald, C.M., Physical activity, health impairments, and disability in neuromuscular disease. Am J Phys Med Rehabil, 2002. 81(11 Suppl): p. S108-20.
2. Warren, J.M., et al., Assessment of physical activity - a review of methodologies with reference to epidemiological research: a report of the exercise physiology section of the European Association of Cardiovascular Prevention and Rehabilitation. Eur J Cardiovasc Prev Rehabil, 2010. 17(2): p. 127-39.

Poster № 39

OPTIMIZING PROTOCOL SELECTION FOR CARDIOPULMONARY EXERCISE TESTING IN SLOWLY PROGRESSIVE NEUROMUSCULAR DISEASES

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Introduction: Peak oxygen consumption (VO_{2peak}) is the golden standard to express aerobic capacity in neuromuscular diseases (NMD). For valid determination of the VO_{2peak}, cardiopulmonary exercise testing (CPET) is recommended to last between 8 and 12 minutes. Predicted peak workload, currently determined based on models for healthy subjects or clinical judgment by the assessor, is used to assess workload increments for CPET in NMD. Applying these methods to the heterogeneous NMD population often leads to tests outside the 8 to 12 minutes window.

Purpose: To develop a predictive model to estimate CPET peak workload in people with slowly progressive NMD.

Methods: A linear regression model was developed based on tests lasting 8 to 12 minutes, with W_{peak} as dependent variable. Determinants significantly associated with W_{peak} ($p<0.05$), after checking for multicollinearity, were included in the model using backward elimination. Potential determinants included: 6-minute walking test (6MWT) distance, gender, age, height, weight, body mass index, and Medical Research Council (MRC) cycle score (i.e. sum of hip extension, knee flexion/extension and plantar flexion). The mean difference between W_{peak} and $W_{peak\text{-}predicted}$ was assessed for all tests with a paired t-test, and Limits of Agreement (LoA) to determine individual bias.

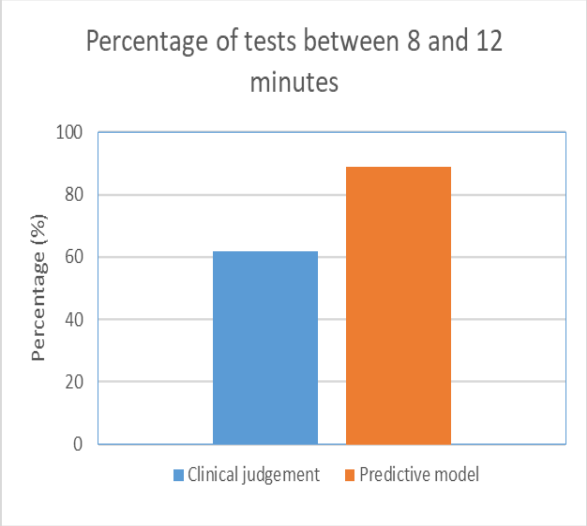

Figure 1. Percentage of tests between 8 and 12 minutes

Results: The database consisted of 118 tests, of which 73 tests lasted between 8 and 12 minutes. Mean age was 58.5 ± 14.0 years, and diagnoses included post-polio syndrome (n=37), Charcot-Marie-Tooth disease (n=49) and other slowly progressive NMD (n=32). The regression analysis resulted in: $W_{peak\text{-}predicted}$ = -15.123 + 0.267*6MWT + 35.953*gender -0.878 *age + 2.422*MRC (R^2=0.648). No significant difference was found between W_{peak} (mean = 126.5 ± 60.6 Watts) and $W_{peak\text{-}predicted}$ (mean = 130. 3 ± 46.6 Watts). The LoA were -79.4, +71.7 Watts. Based on clinical judgement and the predictive model, respectively 73 tests (62%) and 105 tests (89%) lasted between 8 and 12 minutes (figure 1).

Discussion: Our model predicted W_{peak} accurately at group level and it was superior to clinical judgement for predicting CPET workload increments. The next step is to externally validate the model.

Acknowledgements: This project is made possible with funding from the AMS talent call.

Poster № 40

CELLULAR CARDIAC ALTERATIONS IN SIZE AND MITOCHONDRIAL DENSITY AFTER HINDLIMB SUSPENSION IN MICE

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Introduction: Humans have evolved to thrive in an environment with gravity. As such, human physiology is altered when exposed to microgravity. As long-term space travel is a goal for humankind, it is vital to study the effects of microgravity and develop countermeasures. The effects of microgravity can also be felt on earth with physical inactivity. Examples of such populations include people with a sedentary lifestyle, hospitalized patients, and spinal cord injury patients. One vital organ that is impacted by microgravity is the heart. Physical inactivity reduces cardiac volume, but whether this is due to an altered fiber size is unknown. Little information exists about the metabolic changes in cardiomyocytes upon physical inactivity.

Purpose: Here, we study how the heart and cardiomyocyte size, and mitochondrial density are altered upon physical inactivity in a mouse model of hindlimb suspension.

Methods: Physical inactivity in mice (8-10 weeks old) was induced by hindlimb suspension. Nine mice were sacrificed as controls (CON). Ten mice were sacrificed after short-term (3 days), and 11 after long-term (7 days) hindlimb suspension. Hearts were removed, dried, weighed, and frozen in liquid nitrogen. Cross-sectional area (CSA) and succinate dehydrogenase (SDH) activity of the cardiomyocytes were assessed in cryosections. Statistical analysis was performed with ANOVA. Data is presented as mean±stdev.

Results: Body weight was not different between groups (CON: 22.7±0.8 g, short-term: 21.7±1.3 g and long-term: 22.5±1.4 g). Heart weight was reduced in short- and long-term hindlimb suspension (Figure 1). The average cross-sectional area decreased significantly from 184±11 μm^2 in control, to 165±18 μm^2 in long-term hindlimb suspension (Figure 2). Succinate dehydrogenase activity did not differ between the three groups (CON: 9.8±2.6 $x10^{-5}$, short-term: 8.3±2.1 $x10^{-5}$, long-term: 8.6±1.4 $x10^{-5}$ $A_{660}.\mu m^{-1}.s^{-1}$).

Conclusions: The combined decrease in heart weight and cardiomyocyte size suggests that physical inactivity reduces size, but not mitochondrial density in mice.

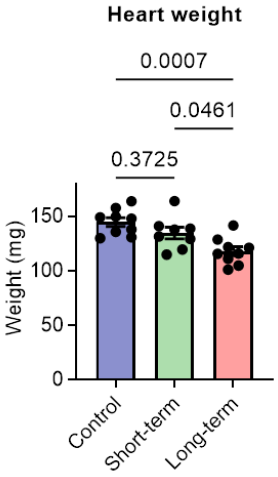

Figure 1: Mean heart weight for control, short-term, and long-term inactivity groups.

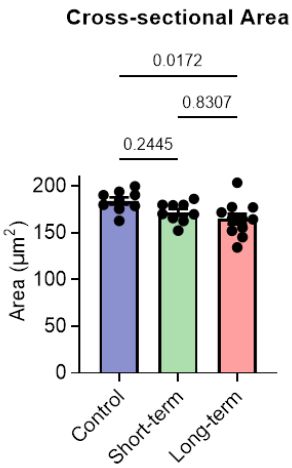

Figure 2: Mean cross-sectional area for control, short-term, and long-term inactivity groups.

Poster № 41

VALIDITY AND RELIABILITY OF THE DUTCH TRANSLATION OF THE OPUS CLIENT SATISFACTION WITH DEVICE MODULE IN CHRONIC HAND ORTHOTIC USERS

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Introduction In the Netherlands, approximately 27,000 people are annually provided with upper extremity orthoses, of which a large part include hand orthoses. Patient satisfaction is an important outcome in assessing quality of care. Yet, no specific instrument assessing orthosis satisfaction is available in the Dutch language.

Purpose To translate the English Client Satisfaction with Device (CSD) module of the Orthotics and Prosthetics Users' Survey (OPUS) into Dutch, and to assess its content validity, structural validity and reliability in persons with chronic hand conditions.

Method The translation was performed using Translation and Cross-cultural guidelines. To determine content validity, the relevance, comprehensibility, and comprehensiveness of the Dutch (D)-CSD were judged by 10 chronic users of hand orthoses and two professionals. Thereafter, in a cross-sectional study, 76 persons of the same population completed the D-CSD twice, with a 2-week interval. Dimensionality of the D-CSD was determined by principal component analysis (PCA). Subsequently, factor model fit was assessed by confirmatory factor analysis (CFA). Internal consistency was determined with Cronbach's α. Test-retest reliability was assessed with the intraclass correlation coefficient (ICC), 95% limits of agreement (LoA), standard error of measurement (SEM) and smallest detectable change (SDC) at individual level.

Results D-CSD items and response options were deemed relevant and comprehensible. After adding an item on cleaning the orthosis, content validity was judged sufficient. The final D-CSD score is summed from 10 items (range: 0-40). PCA indicated a one-factor model, which was confirmed by CFA. Good internal consistency (Cronbach's α=0.82) and moderate to good test-retest reliability (ICC=0.81; 95%CI 0.71-0.87) were found. There was no difference between the mean D-CSD score at T1 (26.78) and T2 (25.92) (mean (SD) difference: 0.86 (4.00); 95%CI -0.06-1.79; p=0.07). The 95% LoA were -6.99 to 8.71, and the SEM and SDC were 2.88 and 7.98 (11% and 30% of the mean pooled D-CSD score) respectively.

Conclusions Based on sufficient content and structural validity, good reliability, but a relatively high SDC, we considered the D-CSD a useful tool to evaluate orthosis satisfaction in persons with chronic hand conditions on group level, since sensitivity to detect changes over time on individual level is limited.

Poster № 42

INVESTIGATING BREATHING PATTERNS OF ASTHMA PATIENTS DURING EXERCISE USING A NOVEL PARAMETER

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Introduction

Exercise induced dyspnoea (EID) in patients with asthma is often attributed to exercise induced bronchoconstriction. However, around 29% of patients with asthma suffer from dysfunctional breathing, which is often overlooked as a factor that can lead to EID. This study investigates (possibly dysfunctional) breathing patterns during exercise in patients with asthma as compared to healthy subjects.

Purpose

The aim of this study is to design a novel parameter to objectify the breathing patterns of subjects in rest and during exercise and using this novel parameter to investigate whether the breathing pattern of asthma patients can be related to asthma symptoms.

Method

Breathing patterns of 15 healthy subjects and 12 asthma patients were compared during a maximal cycling ergometry test. The breathing pattern was quantified with a newly developed parameter called BPratio, which is tidal volume (Vt) divided by breathing frequency (Bf) and predicted vital capacity. Asthma control was assessed by the ACQ, mini-AQLQ and VAS scores.

Results

In the majority of subjects, Vt increased from the start and Bf only increased in the last part of the test, generally considered as a normal pattern. However, in 33% of healthy subjects and 42% of the asthma patients, Bf increased much earlier. This results in a roughly constant BPratio during the majority of the test. The asthma patients who show this deviant breathing pattern experienced worse asthma control than the other asthma patients (ACQ of 1.57 vs 0.14 ($p=0.048$ and mini-AQLQ scores of 4.7 vs 6.7 ($p=0.030$)). Breathing frequency tends to increase when a person experiences discomfort. Therefore, this deviant breathing pattern is likely caused by elevated physical stress perception during exercise.

Conclusions

A deviant breathing pattern, quantified with the novel parameter BPratio, can be related to worse asthma control. This makes the BPratio a promising tool to quantify breathing patterns during exercise, which can support the diagnosis of dysfunctional breathing in asthma patients.

Poster № 43

THE IMPACT OF GAINING EXPERIENCE ON MEASUREMENT ERROR IN PRESSURE PAIN THRESHOLD ASSESSMENT

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Introduction

Pressure pain thresholds (PPT) can be determined reliably, even though variability between assessors exists. Based on motor learning theories, gaining experience could lead to smaller measurement errors. It is unknown what the longitudinal relationship between measurement error and gaining experience is. Insight into this development would aid in how much training is needed and how to optimise PPT measurements further.

Purpose

This study aimed to analyse the effect of experience gained, corrected for confounders, on measurement error. A smaller measurement error is beneficial to achieve higher precision in observing changes, both in research and clinical practice.

Methods

PPTs were determined in two studies (leg-study: tibialis anterior; arm-study: extensor carpi radialis brevis (ECRB)) with six untrained assessors in both studies (physiotherapists: n=3; physiotherapy students: n=3). Assessors received instructions and a demonstration, and performed only one practice measurement. Seventy-two naive participants were measured over three days in each study (twelve new participants each morning and each afternoon over three testing days). Assessors received feedback on the measurements after every block of twelve participants. All data were analysed using the standard error of measurement (SEM) and Linear Mixed Models (LMM), including participant and assessor characteristics.

Results

For tibialis anterior, the SEM improved over the six blocks from 5.7 (95%CI: 5.0 – 6.6) to 4.2 (95%CI: 3.6 – 4.9). For ECRB, the SEM improved from 3.5 (95%CI: 3.0 – 4.0) to 2.4 (95%CI: 2.1 – 2.8). LMM revealed a significant effect of assessor experience (β=-0.2, p=0.035), assessor being a physiotherapist (β=0.64, p=0.02), assessor strength (β=0.01, p<0.001) and participant experience (β=-0.24, p=0.002).

Conclusions

Novice assessors already perform PPTs very reliably without training, while gaining experience further improves reliability. Participant experience also plays a role, highlighting the importance of familiarisation of the participants with the procedures.

Poster № 44

Interaction of the pulmonary, circulatory and muscle systems in response to repeated changes in metabolic demand during upright and supine cycling

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Introduction

Cardiopulmonary exercise testing is a method to derive information of pulmonary, circulatory and muscle systems in response to exercise by measuring gas exchange kinetics. Intermittent exercise resembles exercise in daily life (short bursts of exercise) and elicits multiple responses of these systems which enables a closer evaluation of changes in the responses. Of supine exercise it is known it affects the systems' responses shown by slowed gas exchange kinetics.

Purpose

We combine both intermittent exercise and upright-supine comparisons in our protocol to examine how metabolic responses of oxygen delivery and oxygen uptake on-and off-transient kinetics differ between bouts of exercise. To achieve this, an array of physiological responses (i.e., cardiac output by thoracic impedance measurement, ventilation by breath-by-breath analysis, muscle deoxygenation by near-infrared spectroscopy, muscle activation by electromyography recording) will be measured to determine their contributions to the observed pulmonary oxygen uptake ($\dot{V}O_2$) kinetics in an intermittent protocol.

Methods

15 healthy young adults with normal exercise capacity will be recruited. The subjects will perform five exercise tests. Firstly, a ramp incremental test will be performed to determine the gas exchange threshold (GET) and peak $\dot{V}O_2$. Then on separate occasions, four intermittent tests will be performed: moderate upright and supine at 90% GET and heavy upright and supine at GET + 20%Δ (where Δ represents the difference between GET and peak $\dot{V}O_2$) will be performed in random order. 90 seconds of loaded exercise followed by 90 seconds of unloaded exercise will be repeated 6 times, followed by a 6-min constant loaded bout (Fig. 1). Measured variables will be expressed as ratios to the maximally reached value during the ramp incremental test.

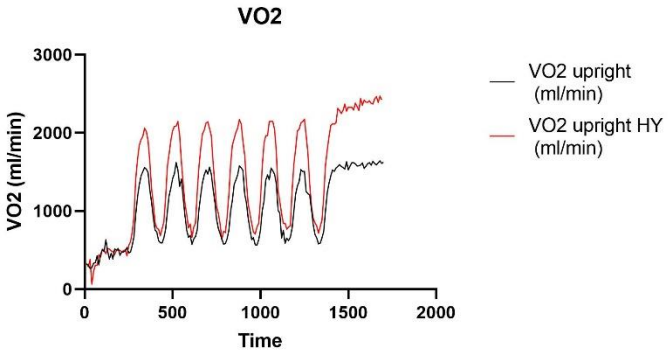

Figure 1. *VO_2 response of moderate and heavy exercise during the intermittent protocol.*

Expected results

It is expected that supine exercise will cause slower $\dot{V}O_2$ kinetics and augmented muscle oxygenation and increased muscle recruitment. In heavy exercise it is expected that the kinetics are slowed relative to moderate exercise, but in later bouts a priming effect could occur (i.e. faster $\dot{V}O_2$ response).

Conclusion

The findings of this study will provide new insights into how above-mentioned systems interact to support rapid changes in metabolic demand.

Poster № 45

ARRAYED HOLLOW CHANNELS ENHANCE OXYGEN TRANSPORT AND OSTEOGENIC ACTIVITY BY MC3T3-E1 PRE-OSTEOBLASTS INSIDE 3D-POROUS SILK SCAFFOLDS FOR LONG-BONE CRITICAL-SIZE DEFECT REPAIR

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Introduction: A high cell death rate in critically sized 3D-scaffolds under low oxygen condition limits their clinical application for large bone defect repair.

Purpose: We aimed to investigate whether arrayed hollow channels would enhance oxygen diffusion and the osteogenic response of pre-osteoblasts inside critically sized 3D-porous silk scaffolds by using finite element (FE) modeling and experiments.

Method: MC3T3-E1 pre-osteoblasts were seeded on 3D-porous silk scaffolds without or with channels (diameter: 0.5 or 1 mm), and cultured up to 21 days. The scaffolds' physicomechanical properties, oxygen distribution, and pre-osteoblast function were investigated by FE-modeling and experimentally.

Results: Arrayed hollow channels did not change pore structure and mechanical properties of the scaffolds. Maximal von Mises stress for 2% compression strain in all scaffolds did not exceed yield stress for bulk-material. FE modeling revealed a higher concentration and more uniform distribution of oxygen, and increased cell proliferation inside channeled (0.5 and 1 mm) 3D-porous scaffolds compared to non-channeled scaffolds. Experimental results indicated that the oxygen concentration significantly increased inside channeled (0.5 and 1 mm) scaffolds by 2.3-2.4-fold compared to non-channeled scaffold at day 14. The increase in cell number was increased by 1.1-1.3-fold inside channeled (0.5 and 1 mm) scaffolds compared to non-channeled scaffolds at day 14. Channeled (0.5 and 1 mm) 3D-porous scaffolds increased *Fgf2* expression at day 4. Channeled (0.5 mm) 3D-porous scaffolds increased *ki67* and *Runx2* expression at day 7, and increased *Ocn* expression at day 21. Cell attachment, ALP activity, as well as collagen and calcium deposition were higher on channeled (0.5 and 1 mm) scaffolds than on non-channeled scaffolds at day 21.

Conclusions: Arrayed hollow channels significantly enhanced oxygen diffusion, and osteogenic activity of 3D-porous silk scaffolds, but did not affect pore structure and mechanical properties, which seems crucial for critically sized scaffolds used for large bone defect repair (Fig. 1).

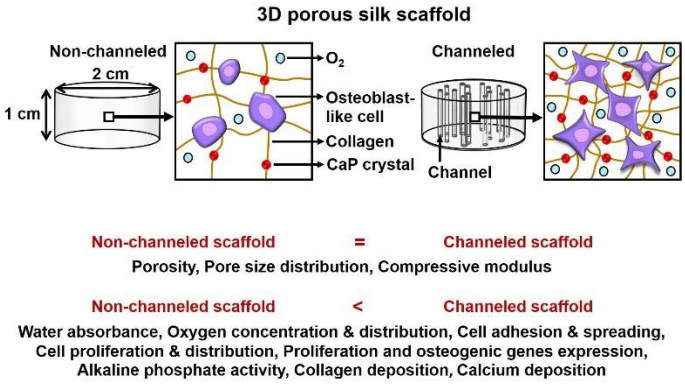

Fig. 1. Arrayed hollow channels enhance oxygen diffusion and osteogenic activity of 3D-porous silk scaffolds, but did not affect pore structure and mechanical properties.

Poster № 46

SKELETAL MUSCLE PHENOTYPE-SPECIFIC EFFECTS OF ACVR1B AND TGFBR1 RECEPTOR SIGNALLING ON MUSCLE TRANSCRIPTOME, FORCE GENERATION AND METABOLISM

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3. Department of Prosthodontics, Affiliated Stomatology Hospital of Guangzhou Medical University, Guangdong Engineering Research Center of Oral Restoration and Reconstruction, Guangzhou Key Laboratory of Basic and Applied Research of Oral Regenerative Medicine, Guangzhou, China

Introduction: Aging and muscle diseases are accompanied by a loss in muscle mass, reduced force generating-capacity, and impaired fatigue resistance. Cytokines from the transforming growth factor-β (TGFT-β) superfamily signal through TGF-β type I receptors ACVR1B and TGFBR1 likely play a role in the induction of of muscle atrophy, weakness, and fibrosis. Recent evidence suggests that targeting TGF-β type I receptors *Acvr1b* and *Tgfbr1* in skeletal muscle results in excessive muscle hypertrophy, particularly in fast-type myofibres.

Purpose: To assess how targeting type I receptors individually and simultaneously (dKO) in fast-and slow-type mouse muscles affects force generating-capacity, phenotype, metabolism and how these effects relate to muscle-type specific alterations in transcriptome.

Methods: *Acvr1b* and/or *Tgfbr1* were specifically knocked out in myofibres of six-week-old mice. After three months, in situ tetanic force and histological phenotype of glycolytic fast-type gastrocnemius and oxidative slow-type soleus muscles were assessed. Whole transcriptome analysis was performed by RNA sequencing and qPCR.

Results: After 3 months, dKO gastrocnemius muscle showed 60% increase in muscle mass while maximal force was increased only by 25% (i.e. 22% reduction in specific force compared to control). In contrast, the slow, high oxidative soleus muscle in dKO showed only a 20% increase in muscle mass while maximal force was increased proportionally. Single receptor knockout caused minor phenotypical alterations. Strikingly, myofiber hypertrophy in both dKO muscles was accompanied by a proportional increase in succinate dehydrogenase enzyme activity and myofibre size. Transcriptome analyses showed that dKO muscles resulted in substantial changes in gastrocnemius medialis (i.e. 1811 differentially expressed genes (DEGs)), while in soleus muscle moderate transcriptome changes were observed (i.e. 295 DEGs). DEGs in dKO gastrocnemius muscle were mainly related to muscle contractile apparatus, hypertrophy, cytoskeleton and oxidative metabolism. Reduced gene expression of β1-sytrophin and increased expression of hepatocyte growth factor are suggested to be involved in muscle hypertrophy and disproportional increase in force.

Conclusions: Our results show that myofibre-specific targeting both TGF-β type I receptors in skeletal muscle causes more DEGs in fast-type muscle while the effect is less pronounced in slow-type muscle. Myofibre size and force-generation capacity are differently affected such that force is not proportionally increased in hypertrophic fast-type muscle, possibly by disruption of transmembrane complex. The lack of TGF-β type I receptors in myofibre seems a unique strategy to concurrently increase both myofibre size and oxidative metabolic capacity.

Poster № 47

Altered Collagen I And Premature Pulmonary Embryonic Differentiation In Patients With OI type II

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ABSTRACT

Introduction

Pulmonary hypoplasia and respiratory failure are primary causes of death in patients with Osteogenesis Imperfecta (OI) type II. OI is a genetic skeletal disorder caused by pathogenic variants in genes encoding collagen type I. It is still unknown if the collagen defect also affects lung development and structure, causing lung hypoplasia in OI type II.

Objective

The aim of this study was to investigate the intrinsic characteristics of OI embryonic lung parenchyma and to determine whether altered collagen type I may compromise airway development and lung structure.

Methods

Lung tissue from nine fetuses with OI type II and six control fetuses, matched by gestational age, was analyzed for TTF-1 and collagen type I expression by immunohistochemistry, to evaluate the state of lung development and amount of collagen.

Results

The differentiation of epithelium into type 2 pneumocytes during embryonic development was premature in OI type II fetuses compared to controls ($p<0.05$). Collagen type I showed no significant differences between the two groups. However, the amount of alpha2(I) chains was higher in fetuses with OI and the ratio of alpha1(I) to alpha2(I) lower in OI compared to controls.

Conclusions

Cell differentiation during lung embryonic development in patients with OI type II is premature and impaired. This may be the underlying cause of pulmonary hypoplasia. Altered cell differentiation can be secondary to mechanical chest factors or a consequence of disrupted type I collagen synthesis. Our findings suggest that collagen type I is a biochemical regulator of pulmonary cell differentiation, influencing lung development.

Poster № 48

ACTIVITY DISTRIBUTION AMONG THE HAMSTRING MUSCLES DURING HIGH-SPEED RUNNING: A MULTICHANNEL EMG STUDY

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Introduction Hamstring injuries during high-speed running have a high incidence.[1] It has been suggested that the bi-articular hamstring muscles (biceps femoris long head, semitendinosus and semimembranosus) are most at risk during the late-swing phase of the stride cycle.[2] Activation patterns differ both within and between the biceps femoris long head and semitendinosus during various exercises. Hamstring injuries might occur because of an inadequate distribution of individual contributions of muscles. A high contribution of biceps femoris long head during strenuous exercise compared to the semitendinosus and semimembranosus was associated with an increased risk of a first-time injury.[3] A better understanding of intramuscular activity patterns may provide more insight in the risk and aetiology of hamstring injuries.

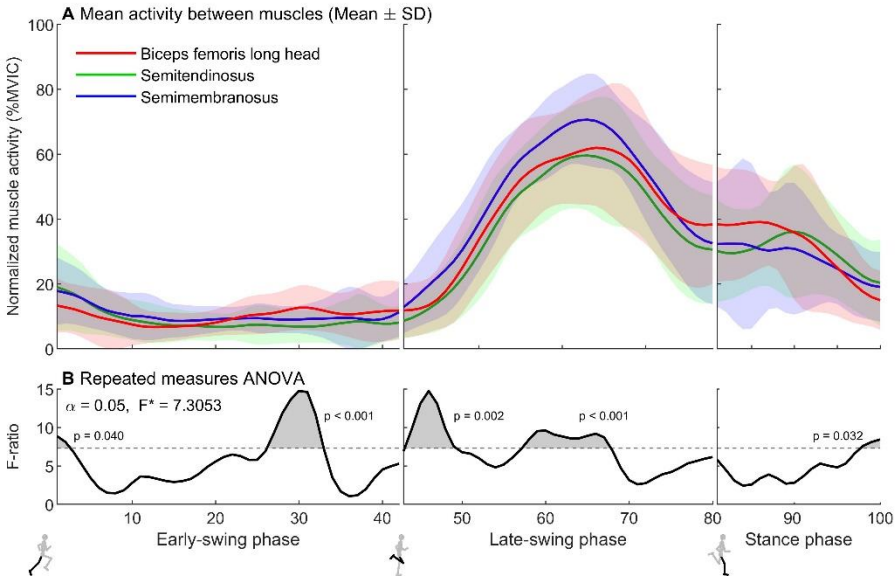

Figure 1. *Muscle activity between hamstring muscles*

Purpose The aim of this study was to characterize muscle activity within and between the three hamstring muscles during high-speed running.

Methods In this descriptive study, participants performed three trials of high-speed running on a treadmill, during which electromyography (EMG) and hip and knee joint angles were measured. EMG was measured at 15 locations to describe muscle activity within and between the individual hamstring muscles. Characteristic changes in knee joint angle were used for time-normalization and phase differentiation. Statistical parametric mapping was used for analyses of muscle activity over time.

Results Twenty-nine non-injured basketball players were included (mean age: 17±1yrs, mass; 85±9kg, height; 193±9cm, running speed; 7.6±0.5m.s^{-1}). Heterogeneous activity was found for all individual hamstring muscles (biceps femoris long head; $df(4,112)$, $F=4.68$, $p<0.05$, semitendinosus; $df(3,84)$, $F=5.65$, $p<0.05$, semimembranosus; $df(5,140)$, $F=4.19$, $p<0.05$) in multiple episodes of the stride cycle. Between muscles, muscle activity differed significantly in the early-swing, late-swing and stance-phase ($df(2,56)$, $F=7.31$, $p<0.05$). In the late-swing phase, muscle activity of the semimembranosus was significantly higher than that of the semitendinosus (Figure 1A-B).

Conclusions Hamstring muscles were most active in the late-swing phase, where it is assumed that most injuries occur. The most affected muscle, the biceps femoris long head, was significantly more active in the late-swing phase in the most proximal region, which corresponds to the most vulnerable area.

[1]Ekstrand ea 2011;39(6):1226-32 [2]Heiderscheit ea 2005;20(10):1072-8 [3]Schuermans ea 2016;44(5):1276-85.

Poster № 49

EFFECT OF TWO ECCENTRIC HAMSTRING EXERCISES ON MUSCLE ARCHITECTURAL CHARACTERISTICS ASSESSED WITH DIFFUSION TENSOR IMAGING

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Introduction There is strong evidence that a 12-week Nordic hamstring exercise (NHE) intervention can reduce hamstring injury rate up to 51%. Although this non-functional exercise is effective in daily practice, the underlying preventive mechanism is yet not fully unraveled. Current literature suggests lengthening of the fascicles, and a change in pennation angle of the biceps femoris long head on two-dimensional ultrasonography. Limitations of two-dimensional ultrasound studies are that findings are predominantly based on a single fascicle and limited to biceps femoris long head. Furthermore, it is discussed whether the NHE is the most appropriate preventive exercise, where hip-orientated exercises are suggested as alternatives as they are executed at a longer muscle length, as this corresponds with the suggested injury mechanism.

Purpose The aim of this study was to evaluate the effect of NHE or Diver hamstring exercise (DHE) on muscle fascicle length and orientation in biceps femoris long head, semitendinosus and semimembranosus through three-dimensional diffusion tensor imaging (DTI).

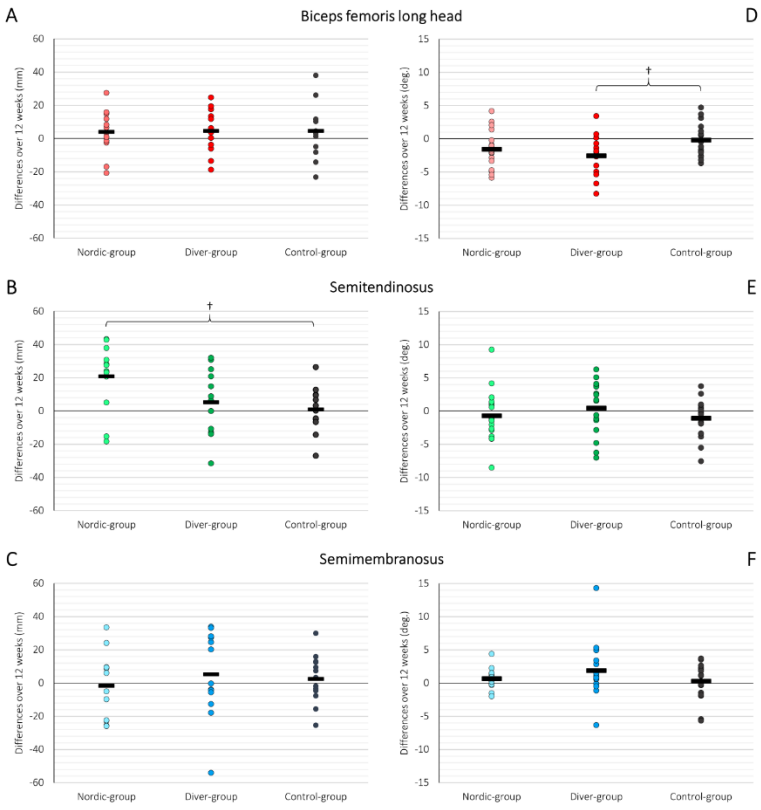

Figure 1. *Primary outcome measures*

Method Male basketball players were randomized to the NHE-group, DHE- group, or Control-group. DTI datasets of the upper-legs were acquired with magnetic resonance imaging at baseline and at follow-up, after a 12-week intervention period. Muscle fascicle length and orientation of the hamstring muscles were extracted from the DTI data with custom-built scripts (Matlab and Mathematica) and tractography software (vIST/e). Changes in the primary outcome measures muscle fascicle length and orientation per muscle over 12-weeks were compared between groups.

Results Datasets of fifty-three participants were used for data analysis. The average age was 22±7yrs, mass; 87±11kg, height; 191±9cm. Fascicle length in the semitendinosus over 12-weeks significantly increased in the NHE-group compared to the Control-group, mean between-groups difference: 19.9mm, 95%CI: 1.9/37.9, p=0.026 (Figure 1B). Fascicle orientation in the biceps femoris long head over 12-weeks significantly decreased in the DHE-group compared to the Control-group, mean between-groups difference: -2.4°, 95%CI: -4.7/0.1, p=0.039 (Figure 1D).

Conclusions The NHE increases fascicle length of the semitendinosus muscle. The DHE intervention decreases muscle fascicle orientation in the biceps femoris long head. A combination of these complementary exercises might be relevant for preventing hamstring injuries.

Poster № 50

THE VALIDITY OF MAXIMAL EXERCISE TESTING TO ASSESS PEAK OXYGEN CONSUMPTION IN PEOPLE WITH SLOWLY PROGRESSIVE NEUROMUSCULAR DISEASES

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Introduction: Maximal exercise testing with respiratory gas analysis is considered the gold standard for the assessment of peak oxygen consumption (VO_{2peak}) and is often used as primary outcome in aerobic exercise studies in slowly progressive neuromuscular disorders (NMD). However, there is a lack of evidence regarding its validity in NMD, which could be limited because upper or lower extremities muscle weakness may predominantly determine exercise performance.

Purpose: To determine the content validity of maximal exercise testing to assess VO_{2peak} in people with slowly progressive NMD.

Method: Eighty-two ambulatory adult subjects (mean±SD age: 58.2±13.7) with a slowly progressive neuromuscular disease participated in the study. Subjects performed a maximal ramp exercise test on a cycle ergometer. VO_{2peak} assessment was considered valid if the primary criterion, or 2 out of 3 secondary criteria for achieving maximal aerobic capacity were met. The primary criterion was achievement of a plateau in oxygen consumption. Secondary criteria were 1) peak respiratory exchange ratio (RER_{peak}) ≥1.1, 2) peak heart rate (HR_{peak}) ≥85% of predicted maximal heart rate, and 3) rating of perceived exertion (RPE) ≥17 on the 6-20 Borg scale. Knee extensor muscle strength was assessed isometrically with a fixed dynamometer (Biodex) and was quantified as the sum score of the maximal voluntary torque of the knee extensors of both legs.

Results: In 71 subjects (87%) VO_{2peak} assessment was considered valid. $VO_{2plateau}$, RER≥1.1, HR_{peak}≥85% and RPE≥17 was achieved in 33%, 73% 78% and 72% of subjects, respectively. VO_{2peak} was significantly lower in subjects scoring a non-valid compared to a valid exercise test (U = 148.5, p =<.001). No significant difference was found for knee extensor muscle strength between these groups, but a trend towards lower muscle strength in subjects scoring a non-valid test was apparent (U = 154.00, p =.075) (Figure 1). No significant differences between groups were found for age, weight or gender.

Conclusions: Maximal exercise testing is a valid measurement of VO_{2peak} in the majority of ambulatory adults with slowly progressive NMD. Knee extensor muscle strength seems to be a determinant of its validity.

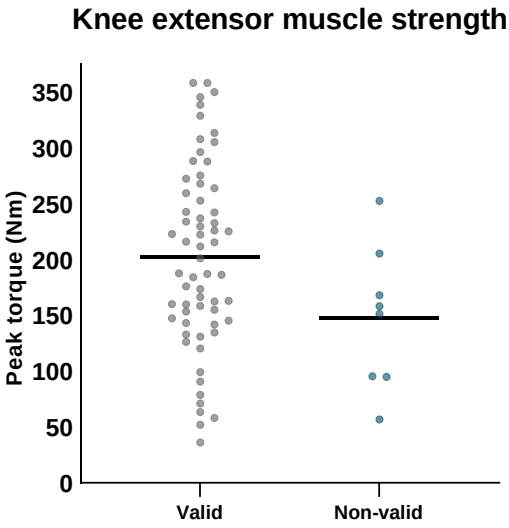

Figure 1: Quadriceps muscle strength in subjects for which assessment of VO_{2peak} was considered valid and non-valid.

Poster № 51

FROM GENETICS TO CLINICAL IMPLICATIONS: A STUDY OF 675 DUTCH OSTEOGENESIS IMPERFECTA PATIENTS

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ABSTRACT:

Introduction

Osteogenesis imperfecta (OI) is a heritable connective tissue disorder that causes bone fragility due to pathogenic variants in genes responsible for the synthesis of type I collagen. Efforts to classify the high clinical variability in OI led to the Sillence classification. However, this classification only partially takes into account extraskeletal manifestations and the high genetic variability. Little is known about the relation between genetic variants and phenotype as of yet.

Purpose

The aim of the study was to create a clinically relevant genetic stratification of a cohort of 675 Dutch OI patients based on their pathogenic variant types and to provide an overview of their respective medical care demands.

Method

The clinical records of 675 OI patients were extracted from the Amsterdam UMC Genome Database and matched with the records from Statistics Netherlands (CBS). The patients were categorized based on their harbored pathogenic variant. The information on hospital admissions, outpatient clinic visits, medication, and diagnosis-treatment combinations (DTCs) was compared between the variant groups.

Results

OI patients in the Netherlands appear to have a higher number of DTCs, outpatient clinic visits, and hospital admissions when compared to the general Dutch population. Furthermore, medication usage seems higher in the OI cohort in comparison to the general population.

Conclusions

The patients with a COL1A1 or COL1A2 dominant negative missense non-glycine substitution appear to have a lower health care need compared to the other groups, and even lower than patients with COL1A1 or COL1A2 haploinsufficiency. It would be useful to include the variant type in addition to the Sillence classification when categorizing a patient's phenotype.

Poster № 52

Title: CHANGES IN MUSCLE FIBER INTEGRITY AND CONTRACTILE FUNCTION DURING *EX VIVO* CULTURE

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Introduction *In vitro* culture of mature muscle fiber explants and their associated satellite cells is an important model that has been mainly used to study muscle regeneration. As these muscle fibers retain their morphology and contractile function, they can also be used as a model to study mature muscle function in health and disease. However, because mature skeletal muscle fibers are post-mitotic, culture time of these explants is limited. Although short-term *ex vivo* cultures are performed continuously, little is known about how culture conditions affect muscle fiber function.

Purpose The first aim of this study was to reveal the functional changes that muscle fibers undergo during *in vitro* culture. The second aim of this study was develop a culture format for isolated muscle fibers, to prolong maximum culture duration.

Methods Mature skeletal muscle fibers from mouse Flexor Digitorum Brevis (FDB) muscles were isolated and subjected to different culture conditions. Tested culture conditions include differences between low serum (1% Horse serum) and high serum (10% FBS), and culture in 2D or 3D format. Muscle fiber health was then evaluated through contractile function, morphology and survival at day 1 and 7 post-isolation. Muscle fiber contractility was assessed by measuring sarcomere length changes using a novel high-throughput contractility assay.

Results Our measurements showed that culture conditions can drastically affect both mechanical function and morphology of isolated muscle fibers. Firstly, culture duration had a significant effect on both morphology and contractile function. Furthermore, exposure to high serum medium caused rapid dedifferentiation, overgrowth of secondary cells and decreased contractile function. Lastly, embedding isolated muscle fibers in a 3D hydrogel matrix significantly reduced the effects of culture duration compared to the 2D cultured group.

Conclusions Our results suggest that culture conditions are a major factor in muscle fiber deterioration during culture, which can have a significant effect on downstream experimental procedures. Although fiber deterioration during culture still occurs, our results show that a low-serum 3D culture format can greatly reduce the severity of this deterioration. Future work will further investigate culture-induced changes in muscle fibers and ways to alleviate them.

Poster № 53

THE EFFECTS OF CUSTOM-MADE FOOTWEAR ON STABILITY DURING WALKING IN PEOPLE WITH DIABETES AND PERIPHERAL NEUROPATHY

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Introduction: Diabetic peripheral neuropathy (DPN) affects both sensory and motor nerves, which leads to a high risk of foot ulceration. Custom-made footwear aims to reduce peak plantar pressures and helps to reduce this risk. However, DPN also introduces balance and stability impairments.[1] While custom-made footwear redistributes plantar pressures effectively it can also introduce more instability during walking, which could lead to a higher fall risk.[2,3]

Purpose: Our aim was to explore the effects of custom-made footwear on stability during walking.

Method: In a cross-sectional design 39 participants (75 feet) with DPN at high risk of ulceration and in possession of custom-made footwear completed both barefoot and in-shoe pressure measurements during walking. From these data, the maximum velocity of the Center-of-Pressure (CoP) was calculated for the loading response, midstance, terminal stance and preswing of stance, and compared for shod vs barefoot walking. An increase in maximum velocity defined an increase in instability. In secondary analysis we compared stability for amputated vs non-amputated feet, where amputated was defined as an amputation at any level of the foot. We used paired and independent t-tests for statistical analyses.

Results: The maximum velocity of the CoP was significantly higher for shod vs barefoot walking during loading response ($t(74)=3.03$, $p=0.003$) and preswing ($t(74)=2.38$, $p=0.020$) (Fig.1). A decrease in maximum velocity of CoP was found during shod walking for amputated vs non-amputated feet during loading response but this was not significant.

Conclusions: Custom-made footwear can increase instability during loading response and preswing of walking in people with DPN. Further research is needed into which footwear design aspects contribute to this change and its effect on biomechanical, clinical and patient-related outcomes.

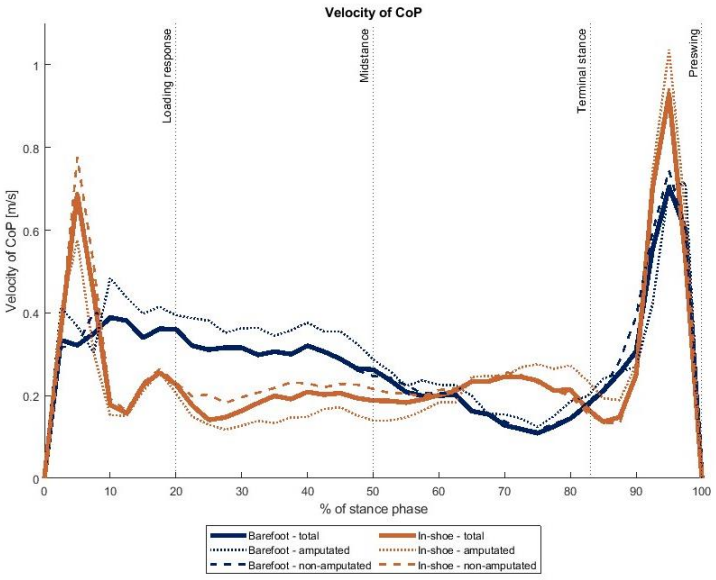

Figure 1 Median velocity of the Center of Pressure in m/s during the stance phase. Data is shown for barefoot and shod walking, and separately for amputated and non-amputated feet.

[1] Brown et al. Diabetes Care. 2015;38(6):1116-22.
[2] Reeves et al. Medicina (Kaunas). 2021;57(5).
[3] Mehdizadeh et al. Exp Gerontol. 2021;143:111170.

Poster № 54

THE EFFECT OF TIBIA BENDING ON IMPLANT DISPLACEMENT MEASUREMENTS FROM 3D-CT IMAGES UNDER EXTERNAL VALGUS-VARUS LOADING: A CADAVER STUDY

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Introduction: Advanced 3D image analysis technology can be used to detect tibia implant loosening after total knee arthroplasty (TKA), based on computer tomography (CT) acquired under external valgus and varus loading conditions. However, exerting valgus-varus loading may cause the tibia to bend which results in an overestimation of implant displacement relative to the tibia.

Purpose: To assess the extent of tibia bending and its effect on measuring implant displacement.

Methods: TKA implants were placed in ten cadaver specimens, first without bone cement fixation (mimicking loose implants) and subsequently with fixation (fixed implants). The legs were CT scanned under valgus and varus loading (20 Nm). Tibia bending was assessed by measuring the relative displacement between the proximal (20% of the total tibia model) and distal (20%) tibia (Fig. 1a). The effect of bending on the observed displacement of uncemented and cemented implants was assessed by quantifying implant displacement relative to the whole tibia (which includes potential bending effect, Fig. 1b) and relative to the proximal tibia (reduced bending effect, Fig. 1c). Additionally, one cadaver specimen with knee implant was repeatedly (n=10) scanned without loading to determine the methodological error associated with each analysis method. The results of the relative displacements were expressed as the magnitude of the translation and rotation ($\sqrt{x^2 + y^2 + z^2}$ and $\sqrt{\varphi x^2 + \varphi y^2 + \varphi z^2}$).

Results: The average relative displacement caused by bending was 1.27±0.50 mm and 0.64±0.25˚, which was significantly larger than the methodological error (0.13 ± 0.06 mm and 0.05 ± 0.03˚). The relative implant displacement as measured between the fixed implant and the whole tibia was 0.39 ± 0.17 mm and 0.79 ± 0.38˚ (significantly larger than the methodological error: 0.03 ± 0.03 mm and 0.08 ± 0.04˚), and was significantly larger compared to measuring implant displacement with respect to the proximal tibia, 0.21 ± 0.11 mm and 0.62 ± 0.34˚ (methodological error 0.07 ± 0.06 mm and 0.08 ± 0.03˚). The differentiation between loose (uncemented) and fixed (cemented) implants improved when tibia bending was compensated for, by using the proximal tibia rather than the whole tibia: the percentage of correctly classified observations improved from 80-90% to 100%.

Conclusion: This study demonstrates the presence of tibia bending under external valgus-varus loading, leading to an overestimation of implant displacement measurement. This influence can be reduced by using the proximal 20% of the tibia as the reference object.

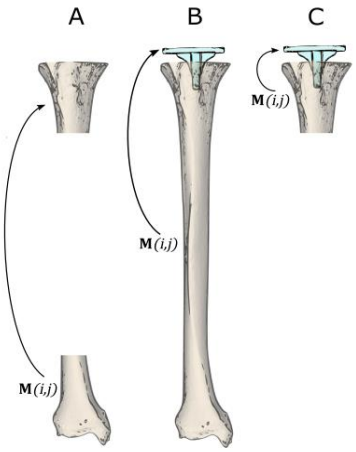

Figure 1: Overview of the investigated relative displacements. A) the proximal (20%) tibia with respect to the distal (20%) tibia to evaluate bending. B) Implant displacement with respect to the whole tibia, and C) with respect to the proximal (20%) tibia, to evaluate the effect of bending on implant displacement measurement.

Poster № 55

PARASPINAL MUSCLE MORPHOLOGY: A NORMATIVE REFERENCE STANDARD AND BETWEEN GROUP COMPARISION FOR PEOPLE WITH AND WITHOUT LBP

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Introduction: Various parameters of paraspinal muscle health (e.g., size, shape, and composition) have been acknowledged as potentially important modifiable biological markers in people with low back pain (LBP). Only modest literature describes the presence of these features in people without LBP. Normative data and between group comparison from a large, representative sample is required to provide a reference standard for clinical outcomes in people with LBP.

Purpose/Aim: 1) To create a reference standard for paraspinal muscle morphology in people without LBP 2) To investigate the magnitude and meaning of paraspinal muscle morphology in people with LBP and without LBP.

Materials and Methods: Participants with acute LBP, chronic LBP and no pain from the UK Biobank were included for this study after screening for eligibility based on imaging quality. A CNN was trained and tested to automatically segment the paraspinal muscles (multifidus, erector spinae and psoas major), and the results were used to establish a reference standard for muscle fat infiltration (MFI) and average cross-sectional area (CSA) in healthy subjects, stratified by age, sex, and BMI sub-profiles. The length of the muscles were normalized by bilinear interpolation to capture level-specific MFI and average CSA across the superior-inferior aspect of the lumbar spine. One-way ANOVA was used to determine between-group differences and corrected for potential confounding factors.

Results:, 10,190 participants without pain, 1,648 participants with acute LBP and 2,381 participants with chronic LBP were included for this study. CNN testing performance was high across all muscles (Sorensen Dice > 0.895). Higher MFI and average CSA for all muscles was found in participants with chronic LBP compared to people with acute LBP and no pain ($p<0.001$). The mean differences for all muscles were level-specific, most profound at the lower lumbar levels and defined by a 'sawtooth' pattern for only the multifidus.

Conclusion(s): This study provides a reference standard for paraspinal muscle morphology in people with and without LBP. Higher levels of MFI were found in people with chronic LBP over people with acute LBP and people without pain, with level-specific mean differences which were most profound at the lower lumbar levels.

Poster № 56

Metformin as potential protective treatment against simvastatin-induced myotoxicity in C2C12 myotubes

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Introduction Polypharmacy, or the use of multiple prescriptions simultaneously, raises increasing concerns, as it has been associated with adverse health outcomes and mortality. A frequent pharmaceutical pairing is the prescription of simvastatin and metformin. Simvastatin is an LDL-cholesterol lowering drug, while metformin is the most frequently used first-line therapy to treat patients with Type 2 Diabetes Mellitus. Statins have been reported to cause myopathy, and it has been hypothesized that metformin could protect against myopathy in those taking statins.

Purpose This study aimed to investigate the effects and the mechanisms of metformin on simvastatin-induced myotoxicity in C2C12 myotubes. The primary objective was to test if metformin protects against simvastatin cytotoxicity, and secondary objectives were to investigate the mechanisms through which this protection is accomplished.

Method C2C12 myoblasts were differentiated into myotubes and were treated with simvastatin, metformin or the combination. Metformin was applied at two different concentrations (50 and 1000 µM) to both control (CON) and simvastatin (SIM) treated cells. We studied myotube diameter, differentiation and fusion index, proliferation, gene expression and associated signaling pathways as outcome parameters of each treatment.

Results Simvastatin decreased myotube diameter after 24-hours ($P = 0{,}0003$) and myotube diameter was further decreased after 72-hours ($P = 0{,}008$). Metformin also induced atrophy in myotubes at both concentrations, however, but to a lower extend compared to metformin. However, metformin mitigated the simvastatin-induced growth suppression ($P = 0{,}0123$). Simvastatin inhibited proliferation, whereas metformin did not. Atrophy gene Murf1 was increased in the SIM group, and was also found to be increased in both CON and SIM cells treated with metformin. Mafbx, another atrophy gene, was not affected by any treatments.

Conclusions Metformin is partly able to mitigate the simvastatin-induced myotoxicity on protein level. However, gene expression analyses were not sufficient to explain this response. Further research is needed to unravel the mechanistic response of the partial protection of metformin against simvastatin.

Poster № 57

VARIABILITY IN RECOVERY FOLLOWING MICRODISCECTOMY AND POSTOPERATIVE PHYSIOTHERAPY FOR LUMBAR RADICULOPATHY: A LATENT CLASS TRAJECTORY ANALYSIS

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Introduction: The clinical course of microdiscectomy and post-operative physiotherapy for lumbar radiculopathy varies substantially. No prior studies assessed this variability by deriving outcome trajectories.
Purpose: The primary aims of this study were to evaluate the variability in long-term recovery following microdiscectomy and postoperative physiotherapy for lumbar radiculopathy and to identify outcome trajectories. The secondary aim was to assess whether demographic, clinical characteristics and patient-reported outcome measures routinely collected at baseline could predict poor outcome trajectories.
Methods: We conducted a prospective cohort study with a 24-month follow-up. We included 479 patients with clinical signs and symptoms of lumbar radiculopathy confirmed by Magnetic Resonance Imaging findings, who underwent microdiscectomy and post-operative physiotherapy. Outcomes were leg pain and back pain measured with Visual Analogue Scales, and disability measured with the Roland-Morris Disability Questionnaire. A latent class trajectory analysis was conducted to identify leg pain, back pain, and disability outcome trajectories. Prediction models for poor outcome trajectories were assessed using multivariable logistic regression analyses.
Results: Several outcome trajectories were identified ('large improvement', 'moderate improvement', 'minimal improvement', and 'relapse'). Approximately one-third of patients (32.6%) belonged to one or more than one poor outcome trajectory. Patients with previous treatment (prior back surgery, injection therapy, and medication use) and those who had higher baseline pain and disability scores were more likely to belong to the poor outcome trajectories in comparison to the large improvement trajectories in back pain, leg pain and disability, and the moderate improvement trajectory in disability. The explained variance (Nagelkerke R2) of the prediction models ranged from 0.06 to 0.13 and the discriminative ability (Area Under the Curve) from 0.66 to 0.73.
Conclusion: The clinical course of lumbar radiculopathy varied following microdiscectomy and post-operative physiotherapy, and several outcome trajectories could be identified. Although most patients were allocated to favorable trajectories, one in three patients was assigned to one or more poor outcome trajectories following microdiscectomy and post-operative physiotherapy for lumbar radiculopathy. Routinely gathered data were unable to predict the poor outcome trajectories accurately. Before surgery, clinicians should discuss the high variability and the distinctive subgroups present in the clinical course with their patients.

Poster № 58

ACUTE EFFECTS OF A STAB LESION ON MECHANICAL PROPERTIES OF THE L4/L5 INTERVERTEBRAL DISC IN THE RAT

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Introduction. Low back pain (LBP) is one of the most common musculoskeletal problems. LBP may coincide with altered motor behaviour due to mechanical changes in mechanical properties of the spine resulting from injury or degeneration (i.e. decreased spine stability), or due to effects of nociception on neuromuscular control. The relative importance of these mechanisms, and their possible interaction, are unknown[1]. Our overall objective is to assess the effects of nociception and spine instability, and their interaction on trunk muscles activity and body movement in a rat model. A first step is to quantify the acute effects of disc lesion on spine mechanical properties.

Purpose. To assess the acute effects of IVD lesion on the mechanical properties of the L4/L5 IVD.

Method. 27 L4/L5 spinal segments were collected from Wistar rats (male/female=14/13, body weight=345.6±85.8 gram, age=12.7±0.7 weeks) within 2 hours after sacrifice, stored at -20℃. Following thawing, bending tests were performed to assess the intersegmental angle-moment characteristics. Specimens were loaded in three target directions (right bending/left bending/flexion) before and after IVD lesion.

Results. SPM analysis indicated that in right bending, no significant changes in angle-moment relationships were found (Fig. 1A), but in left bending and flexion, significantly lower angle-moment curves were found after lesion (Fig.1B-C). Peak stiffness, peak moment, and hysteresis were significantly decreased (6%-11%, effect size: 0.13-0.26) after lesion in all directions.

Conclusions. Stab lesion of the L4/L5 IVD in the rat caused small to moderate acute changes in IVD mechanical properties. We have previously reported the timing of the structural changes of the IVD to this lesion[2], but the relationship between IVD structure and mechanical function has not yet been established. Our next step will be to evaluate the long-term effects of IVD lesion on spine mechanics and neural control of trunk muscles.

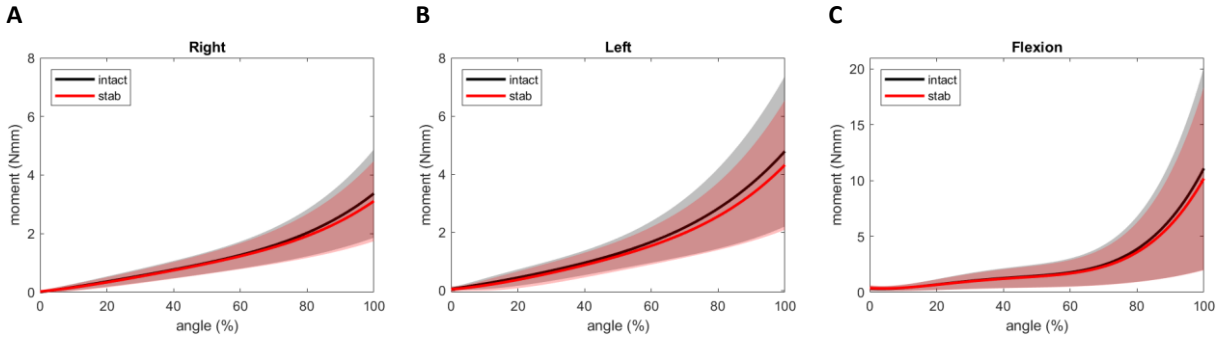

Figure 1. Angle-moment curves in **(A)** Right bending **(B)** Left bending **(C)** Flexion for Intact (black) and stabbed disc (red). Moments are plotted as a function of normalized bending angle, and presented as mean with 95% confidence interval. (sample size: Right=10, Left=10, Flexion=7)

[1]van Dieen JH ea J Orthop Sports Phys Ther. 2019:49(6):370-79.
[2]Maas H ea J Biomech. 2018:70:228-34.

Poster № 59

PHYSICAL INACTIVITY CONTRIBUTES TO CHANGES IN MITOCHONDRIAL DYNAMICS AND THE PRODUCTION OF STRESS-RELEASED MYOKINES

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Introduction: Physical inactivity causes skeletal muscle atrophy and insulin resistance, and reduces oxidative metabolism. Likely, lipotoxicity and altered mitochondrial dynamics and stress underlie these alterations. Skeletal muscle mitochondrial stress induces the production of signaling factors (myokines), such as Fibroblast Growth Factor 21 (FGF21) and Growth Differentiation Factor 15 (GDF15). Depending on the dosage, these myokines have been associated either to healthy aging and improved whole-body energy metabolism, or to metabolic disorders and decreased life-expectancy. The higher levels of both myokines in patients at the intensive care unit are associated with atrophy and mortality. These findings suggest that physical inactivity might be involved in the upregulation of these myokines, and this has not been investigated in muscle disuse models yet.

Purpose: The aim of this study is to determine whether hindlimb suspension in mice induces mitochondrial dynamics dysfunction and stress, and the production of FGF21 and GDF15 in skeletal muscle. I will investigate the relationship of FGF21 and GDF15 gene expression with changes in fibre cross-sectional area (FCSA) and mitochondrial density in the high-oxidative soleus (SOL) and low-oxidative tibialis anterior (TA) muscles.

Method: In total, 30 male mice were subjected to short- (3 days) and long-term (7-10 days) hindlimb suspension and compared to control. Sections of SOL and TA were stained for succinate dehydrogenase (SDH) activity as a marker for mitochondrial density and analysed in ImageJ. Gene expression and protein levels of FGF21 and GDF15, as well as key markers of mitochondrial dynamics will be obtained through qPCR and Western blotting, respectively. Data will be analysed through analysis of variance (ANOVA) and linear regression analysis.

Results: Preliminary results show a significant decrease in FCSA in SOL after long-term inactivity compared to controls with no changes in TA (Figure 1). SDH activity (Figure 2) and integrated SDH activity (Figure 3) were not different in both muscles. Data collection and analysis is still ongoing.

Conclusions: Hindlimb suspension results in a muscle-specific atrophy, but it remains to be determined whether physical inactivity alters mitochondrial dynamics and induces the production of key myokines.

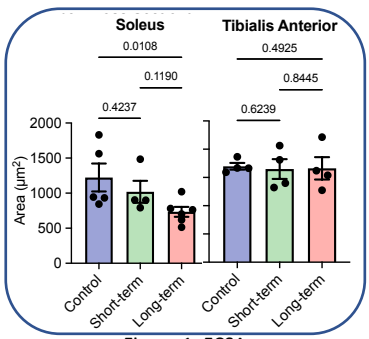

Figure 1. FCSA

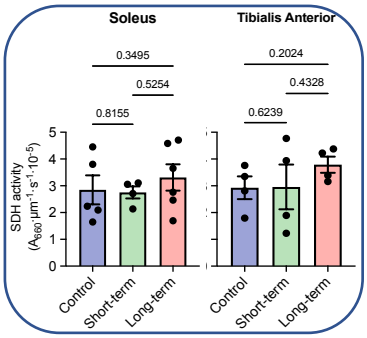

Figure 2. SDH Activity

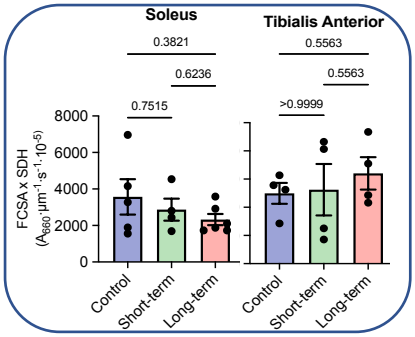

Figure 3. Integrated SDH

Poster № 60

PERSPECTIVES OF ATHLETES WITH A PHYSICAL IMPAIRMENT AND THEIR HEALTHCARE PROFESSIONALS ON SPORTS INJURIES, RISK FACTORS AND CONSEQUENCES: A QUALITATIVE STUDY

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Abstract

Introduction*:* The burden of an injury for an athlete with a physical impairment on daily life activities and sports is big, but little is now known about the athletes' perspective. It's critical to comprehend what sports injuries entail in their entirety.

Purpose: A qualitative study to define sports injuries, risk factors and consequences of injuries as they are perceived by athletes living with a physical impairment and their health care professionals.

Method: Eighteen athletes with a physical motor impairment and 15 healthcare professionals took part in semi-structured interviews, structured according to the Sequence of Prevention. To discover patterns and meaning in data, a thematic analysis was employed with an inductive approach.

Results: Table 1 shows the identified theme's and subtheme's reported by athletes and the healthcare professionals. Injuries are defined by pain and suffering (perception and duration). These perspective are similar, but not identical. Important point was that healthcare professionals mentioned pain as a sign of an injury, whereas some athletes contradicted this and report that having pain doesn't exclusively mean you have an injury. The risk factors of a sports injury is defined by both groups as a disbalance between load and load capacity. Consequences of a sports injury are limitations in activities and participation in daily life and sports. This can also lead to mental consequences.

Conclusions: From our results, we may conclude there are slight differences with regards to injury definition between athletes and healthcare professionals. Furthermore, the disbalance between load and load capacity is an important risk factor as reported by both athletes and healthcare professionals. Due to this agreement, future injury prevention and rehabilitation programs should take this into account when communicating between parties. Due to the slight differences in perspectives, the perspectives of athletes and professionals need to be taken into account when creating or implementing injury prevention programs.

Table 1: Identified theme's and subtheme's

MAIN THEME'S	SUB THEME
INJURY DEFINITION	Signs and symptoms
	Activity limitations
RISK FACTORS	Load increase
	Load capacity
	Balance between load and load capacity
CONSEQUENCES OF INJURY	Limitations in activities and participation
	Personal consequences

Poster No. 61 - not taking part of the Awards competition

NEMALINE MYOPATHY TYPE 6: FROM PHYSIOPATHOLOGY TO THERAPEUTICS

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Introduction: Patients harboring variants in *KBTBD13* (NEM6) display impaired muscle relaxation, which compromises normal muscle function and daily-life activities. Histopathologically, NEM6 is characterized by the presence of myofibers containing nemaline rods and a predominance of type I fibers. The majority of NEM6 patients harbor the Dutch founder mutation (p.Arg408Cys). Recently, we revealed that this variant in *KBTBD13* slows muscle relaxation through an actin-based mechanism. To date, NEM6 phenotype development and progression remains largely uncharacterized and no therapy is available.

Purpose: To characterize functional and morphological natural history of disease in a NEM6 based mouse model harboring the Ducth founder variant to be able to identify therapeutic windows.

Methods and results: NEM6 mice at 1, 3, 9 and 18 months of age were used in this study. Our morphological and functional assays of hindlimb muscles showed that NEM6 mice closely recapitulate human NEM6 phenotype. Slow muscle relaxation and muscle weakness was observed, in addition to the presence of nemaline bodies and type I fiber predominance. This phenotype was absent at 1 month, developed between 1-3 months, and showed little progression after 9 months. Thus, providing us with two therapeutic windows i.e. pre and post phenotype onset.
Our treatment of choice was the short and long term knockdown of mutant *Kbtbd13* transcript in mice at 3 month (treated at 1-month, pre-disease development), 9 month (injected at 7-months, overt disease phenotype) and 9 month of age (injected at 3 month, onset of disease development). Knock-down was achieved by a single intramuscular injection of an AAV9 containing a short-hairpin RNA for *Kbtbd13.* We hypothesized that a reduction of mutant transcript would prevent or reverse disease onset and progression. Our data demonstrate that a single injection knocked down mutant *Kbtbd13* transcript levels by >90% in both short and long term treated mice. This was sufficient to reverse slow relaxation kinetics and type I fiber predominance. Importantly. Long-term knock-down completely reversed accumulation of nemaline rods.

Conclusion: Our results show the natural history of NEM6 in a novel mouse model and the promise of knocking down mutant transcript to prevent and reverse the NEM6 phenotype.