

knee. The treatment was performed during 4 weeks and three times. KOOS (pain section), Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) and pressure pain threshold (PPT) using an algometry on medial and lateral knee compartment, tibialis anterior muscle and trapezius muscle assessed the threshold pain. For statistical analysis it was used a the Shapiro-Wilk and Levene's tests to evaluate the normality and homogeneity assumptions, Student's *t*-test for normal distribution, and the Mann–Witney test for the non-normal distribution. A *P* value 0.05 was considered statistically significant.

**Results:** There was no significant difference when we compared all assessment for both G1 and G2. In the intra-groups assessment, it was found significant results when compared to KOOS Total score for PBM group (*P* 0.015). Until at this moment with twenty patients, we could observe that both group increased the threshold pain of patients and the PBM group showed better values with short neuromuscular training. However, we have preliminary results to confirm these data.

**Conclusions:** The threshold pain did not change after photobiomodulation associated to short neuromuscular training in patients diagnosed with grade 4 of knee osteoarthritis

### 639

#### ORTHOPEDIC AND MEDICAL CHARACTERISTICS OF GAIT WITH THE DRAW-IN MANEUVER IN HEALTHY COMMUNITY-DWELLING OLDER ADULTS

R. Fujita, S. Ota. *Seijoh Univ., Tokai, Japan*

**Purpose:** The prevalence of metabolic syndrome is high in middle-aged and elderly patients with knee osteoarthritis (OA). In particular, diabetes is related to both the occurrence and progression of knee OA, after adjusting for age and body mass index. Therefore, middle-aged and elderly people require certain methods to prevent both knee OA and diabetes. Although exercise and diet therapy have been reported effective in preventing either knee OA or diabetes, to our knowledge, no exercise therapy has been demonstrated to simultaneously prevent both diseases. Knee adduction moment (KAM), which reflects the dynamic load on the medial compartment during gait, can predict radiographic OA progression in patients with knee OA. In diabetes, higher-intensity exercise has additional benefits on maximal oxygen uptake and HbA1c level. The draw-in maneuver, which increases the contraction of inter-abdominal muscles, was introduced to reduce KAM during gait. This maneuver may also increase oxygen uptake and decrease loading on the knee joint. In addition, gait with the draw-in maneuver is considered easy to acquire and can be applied to healthy community-dwelling older adults. This study measured KAM and oxygen uptake during gait with and without the draw-in maneuver and evaluated the orthopedic and medical characteristics of gait with the draw-in maneuver.

**Methods:** Sixteen healthy community-dwelling older adults, consisting of five men and 11 women (mean age, 74.6 ± 5.1 years), participated in this study. The participants were verbally instructed to perform the draw-in maneuver during gait, with any reduction in abdominal circumference confirmed by touch. KAM was evaluated using a three-dimensional motion analysis system and a force plate. Oxygen uptake was measured on 6-min walk tests. Paired *t*-tests were used to determine differences between KAM, mean oxygen uptake, and the 6-min walk distance during gait with and without the draw-in maneuver.

**Results:** No significant differences were observed in the first peak of KAM (0.66 Nm/kg vs. 0.65 Nm/kg), mean oxygen uptake (17.6 ml/kg/min vs. 17.7 ml/kg/min), and 6-min walking distance (513.5 m vs. 526.2 m) between gait with and without the draw-in maneuver. The draw-in maneuver reduced the first peak of KAM in six participants (37.5%) and increased mean oxygen uptake in 10 participants (62.5%), with four subjects (25%) experiencing both changes.

**Conclusions:** Simple verbal instructions resulted in gait modification using the draw-in maneuver, with 25% of the study participants successfully attaining both decreased KAM and increased oxygen uptake. The remaining 75% may not have sufficiently contracted their abdominal muscles when performing the draw-in maneuver. Future studies are needed to measure and confirm the activation of abdominal muscles during gait with the draw-in maneuver. Moreover, healthy community-dwelling older adults may need to satisfy some conditions to have both decreased KAM and increased oxygen uptake during gait with the draw-in maneuver.

### 640

#### THE BENEFICIAL EFFECT OF MAITLAND'S MANUAL THERAPY ON MUSCLE MECHANIC AND KNEE FUNCTION DURING THE TREATMENT OF KNEE OSTEOARTHRITIS

M. Pozsgai †, N. Nusser †, T. Atlasz ‡, M. Váczi ‡. † *Zsigmondy Vilmos Spa and Balneological Hospital of Harkány, Hungary*; ‡ *Univ. of Pécs, Inst. of Sport Sci. and Physical Ed., Pécs, Hungary*

**Purpose:** Purpose: Knee osteoarthritis (KOA) is one of the most highly prevalent degenerative disease of the joints. In this pathological condition, impairment in the muscle mechanic and functional movements of the knee appears. The aim of this study was to investigate the effectiveness of Maitland manual therapy and conservative therapy in patients with KOA. We hypothesised, that Maitland manual therapy has an additional effect, compared with conventional treatment of patients with KOA.

**Methods:** Randomized, controlled clinical trial was performed in the Zsigmondy Vilmos Spa and Balneological Hospital of Harkány, Hungary. Thirty patients (mean ± SD: age 68.63 ± 8.34 years, BMI 21.14 kg/m<sup>2</sup>) with moderate-to-severe symptomatic KOA were randomly assigned to one of two groups. Patients in Maitland group (n = 15, mean ± SD: age 66.26 ± 8.72 years, BMI 21.06 kg/m<sup>2</sup>) received Maitland manual therapy twice a week beside conservative therapy, meanwhile patients in Control group (n = 15, mean ± SD: age 71 ± 7.22 years, BMI 21.22 kg/m<sup>2</sup>) were treated with conservative therapy, included balneotherapy and water-based gymnastic every day, land-based physical therapy and transcatheter electrical nerve stimulation (TENS) therapy three times per week. The study was performed in inpatients care for 3-week period. Baseline and outcome measures were (1) the Visual Analogue Scales (VAS) of five different physical activity; (2) the maximal range of motion (ROM) of active and passive flexion and extension of knee; (3) the muscle strength of flexion and extension muscles of knee; (4) the strength of passive resistance of soft tissue and the degree of flexion of knee at the beginning of pain; (5) the Timed Up and Go (TUG) test and (6) the 6-min Walk Test (6 MWT). Paired sample *t*-test and two-way analysis of variance (ANOVA) were used to analyze the dependent variables. Significance level was accepted at *P* < 0.05.

**Results:** We did not observe significant difference between the average age of the patients in the two groups (*t* = 1.12). The treatment resulted in a significant improvement in all measured outcomes in both groups, except the strength of passive resistance of soft tissue of both knee at the beginning of pain during flexion. Significant enhancements were found in patients following Maitland manual therapy treatment, compared to Control in all VAS scores, except the VAS score of pain felt during turning while walking; active flexion and extension of left knee; passive flexion of both knees; strength of flexion muscles of both knees; the degree of flexion of the knee at the beginning of pain and the 6MWT.

**Conclusions:** The 3-week physical therapeutic intervention program has beneficial effect on patients with KOA. Moreover, Maitland manual therapy has significantly better effect on most of the subjective and objective status of the patients with KOA. This study proved the superior effect of Maitland manual therapy.

### 641

#### USING HOME SENSING TECHNOLOGY TO ASSESS OUTCOME AND RECOVERY AFTER JOINT REPLACEMENT – FINDINGS FROM THE HIP AND KNEE STUDY OF A SENSOR PLATFORM OF HEALTHCARE IN A RESIDENTIAL ENVIRONMENT

S. Grant, M.R. Whitehouse, A.W. Blom, A. Judge, I. Craddock, R. Gooberman-Hill. *Univ. of Bristol, Bristol, United Kingdom*

**Purpose:** Improving outcomes after joint replacement is a key research priority. After joint replacement, up to 30% of patients report minimal improvement or their symptoms get worse and not all patients are satisfied with their outcome. Poor outcomes include continuing pain, functional limitation and increased healthcare utilisation. Patient Reported Outcome Measures (PROMs) such as the Oxford Hip or Oxford Knee Score and the EQ-5D, a measure of health status, are widely used to assess outcome after joint replacement in practice and research. These measures can assess a variety of health outcomes including pain, function and health related quality of life. Though widely used, many PROMs have methodological limitations and there is debate about how to interpret results and definitions of clinically meaningful change. Previously, research has explored the relationship between PROMs and

objective measures, such as timed walks or sit-to-stand tests. Such objective measures are administered in controlled, laboratory style settings, and may not reflect levels of activity in daily life. With the rapid development of monitoring technology, there is opportunity to characterise the relationship between PROMs and behaviour in a natural setting and to develop methods of passive monitoring of outcome and recovery after surgery. We are working with a multidisciplinary team which has developed a system of low powered sensors that can monitor the health-related behaviours of people living at home. The system includes: sensors for the home environment (measuring temperature, humidity, room occupancy, water and electricity usage) a wrist-band body-worn activity monitor and silhouette (body outline) sensors. The SPHERE system of sensors is now being installed in 100 homes belonging to the general population. Within this cohort we are installing the system in the homes of 20 patients who are about to undergo a total hip or knee replacement (THR/TKR). The study aims to: (a) determine to what extent the sensory data obtained from the SPHERE system is comparable to data obtained from routine clinical measures and PROMs in the assessment of patients' activity, function and recovery processes; (b) investigate whether the sensory data can detect meaningful changes in recovery.

**Methods:** To assess the accuracy and usefulness of the sensory data, in this 1-year observational study, patients will be provided with the sensor system to monitor and record daily continuous measurements. We will make and refine appropriate data learning outcomes with the quantitative data e.g., daily measurements in the weeks parallel to the distribution of PROM assessments pre/post-operative (4–9 days, 6 and 12 weeks) and weekly measurements during the other months. The study will assess the relationships between environmental, behavioural and movement data and the parameters of interest from the PROMs assessments over time. Interviews and focus groups with patients and health professional will provide qualitative data and achieve depth in understanding the accuracy of the data, its usefulness for health professionals in decision making, and if the technology is acceptable.

**Results:** The SPHERE sensor system has been installed in the homes of two patients. We aim to recruit up to 20 patients, (aged 18 years or over) whom are due to undergo a TKR or THR in the UK.

**Conclusions:** This study will provide a unique understanding of home and wearable sensor technology in an orthopaedic population and will compare sensor data with current PROMs.

#### 642 CHONDROPROTECTIVE AND ANTI-OXIDANT ACTIVITY OF SPERMIDINE IN HUMAN CHONDROCYTES

Y. Silvestri †, S. D'adamo †, S. Cetrullo †, M. Minguzzi †, S. Guidotti †, G. Filardo †, E. Mariani †, R. Borzi †, F. Flamigni †. †Univ. of Bologna, Bologna, Italy; ‡Rizzoli Orthopaedic Inst., Bologna, Italy

**Purpose:** Osteoarthritis (OA) is the most common form of arthritis and one of the most significant causes of disability in the world. OA mainly affects the major joints such as knee and hip, impairing the structural integrity of articular cartilage. At present, there are unsatisfactory drug treatments since current available pharmacologic therapies are not able to prevent or arrest the development of OA. In this scenario, an alternative and safe opportunity may be represented by nutraceuticals and natural occurring compounds. Among these, spermidine (SPD), an ubiquitous natural polyamine involved in a wide range of cellular processes, is widely recognized to induce autophagy and to reduce the oxidative stress in several cellular models. The object of this study has been to investigate the role of SPD in the context of OA cartilage, evaluating its ability to protect cultured articular chondrocytes against hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>)-induced oxidative stress by modulating the autophagic process.

**Methods:** Chondrocytes, obtained from OA patients undergoing knee arthroplasty, were isolated by sequential enzymatic digestion, expanded *in vitro* and then seeded at high-density. After 24 h starvation, we treated the cells with SPD (100 nM, 24 h) and oxidative stress was induced through incubation with H<sub>2</sub>O<sub>2</sub> (500 μM, 24 h). The extent of cell death was analysed by Flow Cytometry detection of Sytox Green staining, a probe that is instead excluded by viable cells. SPD cytoprotection from oxidative stress was measured by flow cytometric analysis of reduction of γH2AX foci, markers of double strand breaks. Induction of autophagy was also evaluated with Flow Cytometry, evaluating the microtubule-associated protein 1 light chain 3 II (LC3II), a recognized autophagosomal marker. The role of autophagy in SPD cytoprotection

was analysed in another series of experiments performed after the silencing of the autophagic gene ATG5, where cell viability was estimated through the trypan blue exclusion test. Finally, the cells were seeded in chamber slides to evaluate mitophagy (selective degradation of mitochondria by autophagy) by immunofluorescent co-localization of LC3II and TOM20, a mitochondrial outer membrane marker. The extent of SPD modulation of the H<sub>2</sub>O<sub>2</sub>-dependent induction of inflammatory and degradative markers was evaluated by Real Time PCR.

**Results:** SPD pre-treatment was able to reduce the percentage of dead cells after H<sub>2</sub>O<sub>2</sub> exposure. SPD pre-treatment was also able to reduce the induction of OA-related markers promoted by H<sub>2</sub>O<sub>2</sub>: specifically, we found a significant reduction in mRNA expression of several OA markers, such as MMP13, VEGF, RUNX2 and iNOS. The protection afforded by SPD was also confirmed by a significant reduction of the extent of the γH2AX-associated foci after exposure to H<sub>2</sub>O<sub>2</sub>. Furthermore, we detected an increased LC3II signal in cells pre-treated with SPD compared to non-treated controls, indicating SPD ability to induce autophagy in our cellular model. These findings prompted us to further investigating the link between SPD and autophagy by silencing ATG5. Our preliminary data suggested that an efficient autophagy is crucial for the protection afforded by SPD against oxidative stress since SPD cytoprotection was almost lost when ATG5 had been previously silenced. Finally, the results of fluorescence microscopy analysis of the co-localization of mitochondrial and autophagy markers indicate the occurrence of mitophagy in our cellular model, strongly increased by SPD.

**Conclusions:** Our findings highlight the chondroprotective and anti-oxidant activity of SPD and suggest that an efficient autophagy is necessary for the protection afforded by SPD against oxidative stress. Considering the importance of non-invasive strategies in the treatment of OA, we propose SPD as a promising candidate for a non-pharmacologic treatment of OA.

#### Nutraceuticals/ Dietary Supplements and OA

##### 643

#### PREVENTIVE EFFECT OF A PREBIOTIC FIBRE SUPPLEMENT ON THE DEVELOPMENT OF OSTEOARTHRITIS

J. Rios ††, R.A. Reimer †, D.A. Hart †, R.A. Seerattan †, W. Herzog †. †Univ. of Calgary, Calgary, AB, Canada; ‡CAPES Fndn., Brasilia, DF, Brazil

**Purpose:** Obesity, and associated metabolic syndrome, has been linked with a variety of conditions, including musculoskeletal diseases. Using a rat model, we showed that a high-fat/high-sucrose (HFS) diet leads to increased body-fat, insulin resistance, leaky gut, intramuscular fat deposition, and osteoarthritis (OA)-like changes in the rat knee within 12-weeks (metabolic (Met) OA phenotype). Prebiotic fibre supplementation is a countermeasure to combat obesity, modulating body fat, insulin sensitivity, leaky gut, and may protect the knee from OA-like damage in a HFS diet model, but this last point has not been investigated systematically. Thus, the purpose of this study was to determine the effects of a prebiotic fibre supplementation on knee joint integrity in rats concurrently exposed to a HFS diet.

**Methods:** Twenty-four male, 12-week-old, Sprague Dawley rats were randomized into either a HFS diet (40% fat, 45% sucrose – HFS group, n = 12), or a HFS diet combined with prebiotic fibre supplementation (10% oligofructose – HFS+F group, n = 12) for 12 weeks. Eight chow-fed, age-matched animals, were included as lean controls. The primary outcome measures were % body fat, knee joint integrity, insulin sensitivity, cecal microbiota, and a marker of leaky gut (serum endotoxin).

**Results:** Prebiotic fibre supplementation was effective in preventing OA-like changes in the knees of rats exposed to the HFS diet. Moreover, prebiotic fibre supplementation improved insulin sensitivity, Firmicutes/Bacteroidetes ratio, as well as systemic endotoxin (lipopolysaccharide-LPS) levels; thereby normalizing levels of these markers to those of the chow-fed rats. Prebiotic fibre supplementation also resulted in 4% less body fat percent in HFS+F compared to the HFS group animals, however, these differences were not statistically significant (Figure 1).

**Conclusions:** On a background of a diet rich in fat and sugar, prebiotic fibre supplementation was an effective countermeasure for Met OA development. We speculate that the effectiveness of prebiotic fibre supplementation is related to its ability to prevent gut leaking, thereby altering the microbiota composition, which subsequently may have decreased systemic and local inflammation, thus preventing knee joint degeneration.