

**Conclusions:** Individuals with PFJOA had significantly smaller gluteus medius, gluteus minimus and tensor fasciae latae muscles when compared with healthy control individuals. As muscle volume is directly related to peak isometric force output, smaller muscles will tend to be weaker. It is unclear whether hip-abductor weakness is a cause or an effect of PFJOA. Regardless, the present study provides several directions for future research on this relationship

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### RELIABILITY AND VALIDITY OF THE PHYSICAL ACTIVITY SCALE FOR THE ELDERLY (PASE) IN PATIENTS WITH HIP OSTEOARTHRITIS

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**Purpose:** Physical activity (PA) is beneficial in reducing pain and improving function in lower limb osteoarthritis (OA), and is recommended as a first line treatment. Self-administered questionnaires are frequently used to assess level and intensity of PA, but knowledge on reliability and validity of these PA questionnaires are limited, in particular for patients with OA. The purpose of this study was to evaluate the reliability and validity of the Physical Activity Scale for the Elderly (PASE) in patients with hip OA.

**Methods:** Forty patients with hip OA (20 men and 20 women, mean age  $61.3 \pm 10$  years) were included. For evaluation of test-retest reliability PASE was administered twice with a mean time between tests of  $9 \pm 4$  days. Intraclass correlation coefficient (ICC), standard error of measurement (SEM) and minimal detectable change (MDC) were calculated for the total score and for the particular items assessing different PA intensity levels. In addition a Bland-Altman analysis for the total PASE score was performed. Construct validity was evaluated by comparing the PASE results with the Actigraph GT1M accelerometer and the International Physical Activity Questionnaire (IPAQ), using the Spearman rank correlation coefficient.

**Results:** Mean PASE Score at test was  $143 \pm 71$  and at retest  $125 \pm 56$ . The decline in the total PASE score from test to retest was significant ( $p=0.02$ ). ICC for the total PASE score was 0.78, with  $SEM=31$  and  $MDC=87$ , indicating relatively large error of measurement. The lower and upper limit of agreement was  $-65$  and  $100$ , respectively. ICC for the different intensity items was 0.46 for light PA intensity, 0.20 for moderate PA intensity and to 0.68 for vigorous PA intensity. The Spearman rank correlation coefficient between the Actigraph GT1M total counts per minute and the total PASE score was 0.28 ( $p=0.110$ ), and ranged from 0.10 to 0.35 for the different PA intensity categories. The Spearman rank correlation between IPAQ and PASE was 0.61 ( $p=0.001$ ) for the total scores.

**Conclusions:** In patients with hip OA the test-retest reliability of the total PASE score was moderate, with acceptable ICC, but with large measurement errors. The construct validity of the PASE was poor when compared to the Actigraph GT1M accelerometer. Test-retest reliability and construct validity revealed that the PASE was unable to assess PA intensity levels. PASE is not recommended as a valid tool to examine PA level for patients with hip OA.

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### NEUROMUSCULAR EXERCISE (NEMEX-TJR) IMPROVES KNEE EXTENSION MUSCLE POWER AND CHAIR STANDS ABILITY IN PATIENTS WITH SEVERE KNEE OSTEOARTHRITIS COMPARED TO CONTROLS: A RANDOMIZED CONTROLLED TRIAL

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**Purpose:** Knowledge on effects of exercise in patients with severe and end-stage OA is sparse. The purpose was to evaluate the effect of

a neuromuscular exercise program (NEMEX-TJR) on objective functional performance and muscle power in patients with severe knee OA.

**Methods:** *Design.* Randomized controlled trial (NCT01003756) using a sequence of opaque envelopes stratified for sex and municipality. 81 patients, 60% female, scheduled for primary knee replacement at Svendborg Community Hospital, Odense University Hospital, Denmark were included. *Intervention.* Participants were randomized to care-as-usual (verbal and written preoperative information) only, or care-as-usual plus an eight-week neuromuscular exercise intervention (NEMEX-TJR). The intervention was supervised by a physical therapist, and offered twice a week with each session lasting one hour. The intervention is feasible and safe in this patient group and previously described in detail. Assessments were carried out at baseline and one week after the last exercise session and prior to surgery. *Outcomes.* For this sub-study of the RCT, the following exploratory outcomes were assessed: 20-m walk at maximal pace, 5 repeated chair stands timed, maximal unilateral multi-joint leg extension power and maximal unilateral single-joint knee extension power. Muscle power variables was evaluated with a leg extension press (Nottingham Power Rig, Nottingham University, Nottingham, UK) and a seated knee extension machine (Oemmebi, Moglia, Italy) equipped with a linear encoder (MuscleLab Power, Ergotest Technology, Langesund, Norway), respectively. Test assessors were blinded to the allocation and had no access to previously obtained data. Statistical analyses were based on analysis of covariance (ANCOVA), with a factor for group allocation, and the level at baseline, BMI and age applied as covariates to reduce the random variation. No interaction terms were included in the analysis. All statistical inferences are given as between group mean differences with 95% confidence intervals (95% CI).

**Results:** The two groups differed at baseline in BMI, where the intervention group was less obese  $30.8 \pm 4.9$  kg/m<sup>2</sup> vs.  $33.4 \pm 5.8$  which we subsequently adjusted for in the ANCOVA. The intervention group attended a mean of 13 sessions. In favor of the intervention group, the between-group difference was statistically significant for chair stands ( $-1.9$  [95% CI:  $-3.5$  to  $-0.2$ ] seconds,  $P=0.026$ ) and knee extension power for the leg scheduled for surgery ( $13.8$  [95% CI:  $4.7$  to  $23.0$ ] W,  $P=0.004$ ). No differences were found for 20-m walk max pace, multi-joint leg extension power and single-joint knee extension power on the contra lateral leg.

**Conclusion:** Eight weeks neuromuscular exercise according to the NEMEX-TJR program improves chair stands and knee extension muscle power in the leg scheduled for surgery in patients with severe OA of the knee joint.

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### PREVALENCE OF RADIOGRAPHIC PATELLOFEMORAL AND TIBIOFEMORAL OSTEOARTHRITIS IN INDIVIDUALS WITH CHRONIC ANTERIOR KNEE PAIN: DATA FROM A RANDOMISED CLINICAL TRIAL

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**Purpose:** Chronic anterior knee pain (AKP), or pain around the patellofemoral joint (PFJ), is a common condition in younger adults that impacts significantly on participation in a physically active lifestyle. It is associated with a stereotypical set of symptoms, whereby pain is aggravated by activities that increase the load on the PFJ. There is emerging evidence that AKP may not be self limiting, and it is possible that that chronic AKP may precede PFJ osteoarthritis (OA), an important source of knee OA symptoms. Despite the burden of chronic AKP and PFJ OA and their proposed continuum of disease, there is a dearth of high-quality evidence regarding the relationship between them. Thus, there is a clear need for studies to quantify the prevalence of radiographic OA in the PFJ, and the tibiofemoral joint (TFJ) in individuals with chronic AKP.

**Methods:** Individuals with chronic AKP were recruited as part of a randomised clinical trial. To be included, participants had to be aged  $> 40$  years with (i) anterior- or retro-patellar knee pain aggravated by at least two activities that load the PFJ (eg stair ambulation, squatting and/or rising from sitting); and (ii) pain during these activities present on most days

during the past months. Participants were excluded if they (i) exhibited concomitant pain from other knee structures; (ii) described current or previous physiotherapy for knee pain (prior 12 months); and (iii) knee or hip arthroplasty or osteotomy.

Radiographic severity of TFJ OA was assessed from a semiflexed, posteroanterior weight-bearing short film radiograph with the feet externally rotated by 10°. Radiographic severity of PFJ OA was assessed from weight-bearing skyline radiographs, with the knee positioned at 30–40° knee flexion. Severity of radiographic OA was assessed by the same two examiners (KMC, RSH) from digital radiographic images, with meetings to discuss discrepant findings and obtain consensus when required. The Kellgren and Lawrence (K/L) score was assigned in a manner previously described in the literature, to both the TFJ and to the PFJ. Furthermore, separate gradings were conducted on the medial and lateral components of the PFJ. Inter-rater reliability ( $\kappa$ ) for grading TFJ and PFJ radiographic OA on a subset of 39 participants ranged from 0.745–0.843.

**Results:** 224 individuals with chronic AKP (115 (51%) women, mean±SD: age 54±10 yrs, height: 1.69±0.10 m; weight 79±15 kg; body mass index (BMI) 27±4 kg.m<sup>-2</sup>) were recruited into this study. 67 (30%) had no radiographic OA, 57 (25%) had isolated PFJ OA, 2 (9%) had isolated TFJ OA and 98 (44%) had combined PFJ and TFJ OA. Within the TFJ, 123 (55%) had no TFJ OA, 56 (25%) had mild TFJ OA and 45 (20%) had moderate/severe TFJ OA. For the lateral PFJ, 91 (41%) had no PFJ OA, 83 (37%) had mild PFJ OA and 50 (22%) had moderate/severe PFJ OA, while for the medial PFJ, 103 (46%) had no OA, 76 (34%) had mild PFJ OA and 45 (20%) had moderate/severe PFJ OA.

In those 80 participants (36% of cohort) who were aged between 40 and 50 yrs (38 (48% women, age 45±3 yrs; height 1.70±0.10 m, weight 79±17 kg, BMI 27±5 kg.m<sup>-2</sup>), 36 (45%) had no radiographic OA, 21 (37%) had isolated PFJ OA, 1 (1%) had isolated TFJ OA and 22 (28%) had combined PFJ and TFJ OA.

**Conclusions:** The majority (70%) of people presenting to this trial with chronic AKP had radiographic signs of OA. The prevalence of PFJ OA (67%) was greater than the prevalence of TFJ OA (51%), and the medial and lateral PFJ appeared to be affected similarly. The prevalence of radiographic OA was still considerable (55%) in individuals aged 40–50 years, with high rates of PFJ OA (54%). PFJ OA appears to be an important problem in individuals with chronic AKP and future studies need to investigate the link between AKP in individuals less than 40 years and the development of PFJ OA.

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### IMMEDIATE EFFECTS OF UNLOADER KNEE BRACE ON KNEE PAIN AND CONFIDENCE IN INDIVIDUALS WITH OSTEOARTHRITIS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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**Purpose:** Anterior cruciate ligament reconstruction (ACLR) is a well recognized risk factor for post-traumatic knee osteoarthritis (OA). Post-traumatic knee OA can have a substantial impact on quality of life (QOL), general and mental health, and participation in exercise and work-related activities, particularly in younger individuals. Thus, targeted conservative interventions with the potential to reduce pain and improve QOL are urgently required. This study aimed to evaluate the immediate effects of the unloader knee brace on (i) pain; and (ii) confidence in the knee during functional tasks, in individuals who have developed post-traumatic knee OA 5–12 years post-ACLR.

**Methods:** Twenty-eight participants who had undergone ACLR between 5–12 years prior, were aged ≥ 18yrs at the time of surgery, and had current symptomatic and radiographic tibiofemoral and/or patellofemoral OA (Kellgren and Lawrence ≥ 1) were recruited for this within-subject randomized clinical study from medical and health practitioner referrals, our existing database and advertisements. To determine the severity of OA symptoms and to characterize the cohort, the Knee Injury and Osteoarthritis Outcome Score (KOOS) was obtained at the beginning of the session. Knee pain and confidence were assessed during a battery of four functional tasks including single-leg hop for distance, side to side hop, single leg rise and the step down test (5 repetitions of stepping down from a step to tap

their control leg to the floor). After baseline assessment, knee pain and confidence were assessed via visual analogue scales, in a blinded manner under two testing conditions: (i) adjusted brace (anterior-posterior stability and varus/valgus adjustment); (ii) unadjusted brace (anterior-posterior stability, no varus/valgus adjustment). The order of conditions was randomized via concealed allocation and applied by a second investigator. Data were analyzed with non-parametric tests and p<0.05 was considered statistically significant.

**Results:** Twenty-eight participants (13 male, 15 female), age (mean±SD) 45±11.6yrs, height 1.72±0.08m, body weight 78±15 kg, were tested. The KOOS-symptoms was 62±29, KOOS-pain was 59±37, KOOS-ADL (activities of daily living) was 59±42, KOOS-sport and recreation was 61±29 and KOOS-knee related QOL was 59±26. There was a significant bracing effect, with reduced pain during the step down test (p=0.035) and greater confidence during the single leg hop for distance (p=0.004), side to side hop (p=0.003) and single leg rise (p=0.006) in the braced conditions. There were no differences observed between the adjusted and unadjusted brace conditions except for confidence during the single leg rise, where greater confidence was observed when wearing the adjusted brace than the unadjusted brace (p=0.025).

**Conclusions:** In younger individuals with post-traumatic knee OA following ACLR, the unloader knee brace resulted in greater knee confidence in single leg hop, side to side hop and single leg rise tasks, and reduced pain in the step down task. Confidence with the single leg rise, was the only measure to improve with the varus/valgus adjustment

## Spine & Intervertebral Disc

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#### ABNORMAL UP-REGULATION OF $\beta$ -CATENIN SIGNALING LEADS TO SEVERE DEFECTS IN INTERVERTEBRAL DISC TISSUE

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**Purpose:** The incidence of low back pain is extremely high and is often linked to the intervertebral disc (IVD) degeneration. The mechanism of this disease is currently unknown. In this study, we have investigated the role of  $\beta$ -catenin signaling in IVD tissue function.

**Methods:**  $\beta$ -catenin protein levels were measured in disc samples derived from patients with disc degeneration and normal subjects by IHC. To generate  $\beta$ -catenin conditional activation (cAct) mice, *Col2a1-CreER<sup>T2</sup>* transgenic mice were bred with  $\beta$ -catenin<sup>flox/flox</sup> mice. Changes in disc tissue morphology and function were analyzed by micro-CT, histology and real-time PCR assays.

**Results:** We found that  $\beta$ -catenin protein was up-regulated in disc tissues from patients with disc degeneration. To assess the effects of increased  $\beta$ -catenin on disc tissue we generated  $\beta$ -catenin cAct mice. Overexpression of  $\beta$ -catenin in disc cells led to extensive osteophyte formation in 3- and 6-month-old  $\beta$ -catenin cAct mice which were associated with significant changes in the cells and extracellular matrix of disc tissues and growth plate. Gene expression analysis demonstrated that activation of  $\beta$ -catenin could induce Runx2-dependent *Mmp13* and *Adamts5* up-regulation. Moreover, genetic ablation of the *Mmp13* or *Adamts5* under  $\beta$ -catenin cAct background, or treatment of  $\beta$ -catenin cAct mice with a specific MMP13 inhibitor, ameliorated the mutant phenotype.

**Conclusions:**  $\beta$ -catenin signaling pathway plays a critical role in disc tissue function. These findings provide significant insights into the regulatory mechanism of disc function and establish a potential molecular target for the treatment of degenerative disc disease.

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#### CELL LINES FOR THE HUMAN INTERVERTEBRAL DISC: NUCLEUS PULPOSUS AND ANNULUS FIBROSIS

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