Experimental Gerontology 72 (2015) 29–37

Contents lists available at ScienceDirect

Experimental Gerontology

journal homepage: www.elsevier.com/locate/expgero

Exercise in knee osteoarthritis – preliminary findings: Exercise-induced pain and health status differs between drop-outs and retainers

David Beckwée [a,b,*], Ivan Bautmans [b], Thierry Scheerlinck [c], Peter Vaes [a]

[a] Rehabilitation Sciences Research Department, Vrije Universiteit Brussel, Laarbeeklaan 103, B-1090 Brussels, Belgium
[b] Frailty in Ageing Research Department, Vrije Universiteit Brussel, Laarbeeklaan 103, B-1090 Brussels, Belgium
[c] Department of Orthopaedic Surgery & Traumatology, UZ Brussel, Laarbeeklaan 101, B-1090 Brussels, Belgium

ARTICLE INFO

Article history:
Received 24 January 2015
Received in revised form 8 September 2015
Accepted 9 September 2015
Available online 12 September 2015

Section Editor: Christiaan Leeuwenburgh

Keywords:
Aging
Osteoarthritis
Knee
Exercise
Drop-out

ABSTRACT

Background: Exercise effectiveness is related to adherence, compliance and drop-out. The aim of this study is to investigate if exercise-induced pain and health status are related to these outcomes during two exercise programs in knee osteoarthritis patients.
Methods: Symptomatic knee osteoarthritis patients were randomly allocated to a walking or strengthening program (N = 19/group). At baseline, patients were categorized according to their health status. Exercise adherence and compliance were calculated and drop-out rate was registered. For exercise-induced pain, patients rated their pain on an 11-point numeric rating scale (NRS) before and after each training session. Before each session the maximal perceived pain of the last 24 h (NRS_{max24}) was assessed. Patients rated their global self-perceived effect (GPE) on a 7-point ordinal scale after the intervention period.
Results: 53% of the participants felt they improved after the program, 6 patients dropped out. The mean adherence and compliance rates were higher than .83 in both groups. Worse health and higher exercise-induced pain were seen in drop-outs. NRS_{max24} during the first 3 weeks did not significantly increase compared to baseline, but correlated negatively with adherence during the home sessions ($-.56$, $p < .05$). Lower adherence during supervised sessions was significantly related with higher pre-exercise pain scores ($\rho = -.35$, $p < .05$).
Conclusion: Patients who drop-out show a worse health condition and higher exercise-induced pain levels compared to patients that retained the program.

1. Introduction

Osteoarthritis (OA) is characterized by a degeneration of articular cartilage in synovial joints. Pain and disability due to OA of the knee or hip occur in 40% of people aged 65 and over (Dawson et al., 2004; Mannoni et al., 2003). Because OA is considered as an irreversible condition, the treatment is focused on reducing physical disability and controlling pain while minimizing the potentially harmful side effects of pharmacotherapy (Zhang et al., 2007).

Exercise therapy is considered effective for knee OA-related pain and disability (Fransen and McConnell, 2008), and recommended as 'first choice conservative treatment' by several clinical guidelines (Bruyere et al., 2014; Fernandes et al., 2013; McAlindon et al., 2014). In the recent update of the Osteoarthritis Research Society International (OARSI) guideline for knee OA, treatment recommendations are provided for four clinical phenotypes of knee OA (McAlindon et al., 2014). These subtypes are based on whether OA is seen solely in the knee joint or in combination with other joints being affected. They are also based on the presence or absence of co-morbidities. Chan et al. reported on average 3.2 co-morbidities in knee OA patients: 78% had at least one musculoskeletal and 82% had at least one non-musculoskeletal co-morbidity (Chan et al., 2009). The rationale for the stratification of patients in the aforementioned guideline was that co-morbidities might influence treatment choices. However, the available information concerning the impact of co-morbidities on exercise outcomes in patients suffering from knee OA is limited and, therefore, exercise is recommended in the OARSI guidelines as a core treatment for all phenotypes.

Although several meta-analyses found short-term benefits of exercise in knee OA patients, effect sizes are small to moderate (Fransen and McConnell, 2008; Iversen, 2012; Jansen et al., 2011a). Moreover, not all knee OA patients that participate in an exercise program perceive a beneficial effect. For example, Veenhof et al. reported that only 37 of 90 (41%) and 37 of 102 (36%) knee OA patients reported to be improved after 13 weeks of following a behavioral graded activity exercise program, respectively a usual care program including exercises (Veenhof et al., 2006). Bennel et al. reported that 59% of knee OA patients indicated to be improved after 12 weeks of receiving a physiotherapy program (including exercises) (Bennell et al., 2005). A sufficiently high adherence, i.e. the number of sessions attended divided by the number of sessions prescribed, has been shown to be an important prerequisite for the exercise-induced benefits (Holden et al., 2014; Marks, 2012;

* Corresponding author.
E-mail address: david.beckwee@vub.ac.be (D. Beckwée).

http://dx.doi.org/10.1016/j.exger.2015.09.009
0531-5565/

Roddy et al., 2005). Moreover, non-adherence is suggested as an explanatory factor for the declining positive effects of exercise when patients are followed-up over time (Bennell et al., 2014; Marks, 2012; Pisters et al., 2010). Adherence may be influenced by several factors. In his literature review, Marks reported personal factors that influence exercise adherence in the patients with knee OA, including the ability to tolerate exercise-induced discomfort and impaired general health status (Marks, 2012). Adherence should be distinguished from drop-out which can be defined as patients that withdraw before completing an exercise program or study (Cyarto et al., 2006). In a randomized controlled trial, Thomas et al. reported that only 48% of the 226 subjects with knee pain that were allocated to receive exercise therapy, completed a two year home based exercise program that was designed to maintain and improve the strength of muscles acting around the knee, the range of motion at the knee joint, and locomotion function (Thomas et al., 2002). The most common reasons for drop-out were related to pain (of the back and/or hip) and lack of time. Moreover, patients that dropped out were more likely to be aged over 75, and have higher baseline pain scores as reported in a postal questionnaire. In a phenomenological study, the presence of pain has indeed been shown to be an important barrier to initiate and continue exercise in people with osteoarthritis (Petursdottir et al., 2010). Effectiveness of exercise therapy may be related to adherence and drop-out, but also to the extent to which patients comply with the prescribed program (e.g., in terms of duration, intensity, frequency) (Cyarto et al., 2006). Ettinger et al. reported that pain and function improved in a walking and in a strengthening group with an increased adherence, defined as the number of exercise sessions completed, divided by the total number of sessions prescribed (Ettinger et al., 1997). Moreover, the Cochrane meta-analysis of Fransen et al. reported that the number of supervised sessions influenced the effect sizes for pain and physical function (Fransen and McConnell, 2008). This finding was empowered by the more recently published meta-analysis of Juhl et al., although only for aerobic interventions (Juhl et al., 2014).

The study presented here is a sub study of the Knee Osteoarthritis Exercise Therapy (KNOET) study which aims to compare the effect of an aerobic and a strengthening exercise program on the volume of bone marrow lesions in the tibiofemoral joint and serum inflammatory parameters. The KNOET study was approved by the internal human institutional review board and participants provided written informed consent. Recruitment for the KNOET study is done in blocks of maximum 20 patients. At the moment, recruitment is still ongoing and 3 blocks of patients (n = 39) have finished the study. The aim of the present sub study is to investigate the relationship between the patient's adherence, compliance and drop-out and exercise-induced pain which was considered a safety variable (adverse event) in the KNOET study, since it may cause drop-out. Additionally, the present sub study also assed the influence of baseline health condition (including health category and comorbidities). The interim-analyses presented here were performed to anticipate adverse events, drop-outs, low adherence and/or compliance in the next recruitment waves of the KNOET study.

2. Methods

2.1. Participants and randomisation

Community-dwelling volunteers aged 50 or older with a painful knee in the last 30 days and radiographic tibiofemoral osteoarthritis were recruited through advertisements (posters and local media). Selection criteria were based on the criteria defined by the American College of Rheumatology for knee osteoarthritis (Altman, 1995). Exclusion criteria include inability to come to the hospital for assessments and therapy, intra-articular steroid injections in the previous six months, a (systemic) arthritis condition other than OA, contra-indications for physical exercise, or an unstable medical condition. All participants were initially screened by telephone for eligibility and if appropriate they were invited for a radiologic examination and a medical screening with an orthopedic surgeon. All subjects were involved in a stratified parallel-group intervention study with balanced block randomization of the patients [2:2] and blinded assessment. After baseline assessment, subjects were randomly allocated to one of two treatment groups. To keep both intervention groups balanced, randomization was stratified by age, sex, knee alignment and Kellgren and Lawrence (KL) grades. Randomization was performed in blocks of two (one for each intervention group), using a computer generated table of random numbers. Hence, we used two boxes: one for each sex. In each box, subgroups were made for three age categories: [50–65 years]; [65–75 years]; [75 + years]. In each age category, subgroups were made for knee alignment: neutral, >5° varus and >5° valgus. In each alignment subgroup, two subgroups were made for KL grades: one for grades 1 and 2; and another for grades 3 and 4. The numbering of the cards started at one and ended at 72. Each number corresponded to the allocation to one of both intervention groups. At the start of the study, each KL category contained one allocation card to each intervention program. Each time a new patient was included, a card was taken out of the corresponding box and the card number was written on the intervention form. When the two cards of one category were used, both were put back in the box, so that a second round could start. A list of card numbers and the corresponding treatment was provided to the therapists but not to the researchers enrolling and assessing participants. Allocation was revealed to the treating physiotherapist at the time the participant presented the first time for treatment.

Data was collected at the University Hospital Brussels (Universitair Ziekenhuis Brussel) from April 2012 to March 2014. The medical ethics committee of the University Hospital Brussels (Vrije Universiteit Brussel) approved the study protocol (B.U.N. 143,201,213,184) and all participants provided a written informed consent.

2.2. Exercise intervention

Participants were allocated to one of two standardized exercise programs: strength training (ST) or walking training (WT). Both programs were performed three times weekly. The total intervention period consisted of 54 training sessions over a period of 18 weeks, among which 18 supervised sessions at the university hospital and 36 unsupervised sessions at the participants' homes. The first three weeks, all participants trained three times per week under supervision of a trained physiotherapist at the University hospital. Afterwards, the number of weekly supervised sessions was gradually reduced as shown in Table 1. During the last 12 weeks, participants were invited to 4 booster sessions once every three weeks to assess their ability to precisely replicate the exercises. The ST sessions lasted 45 min each and consisted in 7 exercises that focused on strength and functional performance of quadriceps, hamstring, hip abductor and hip adductor muscles (Table 2).

The WT program consisted of walking for 40 min at an intensity of 14 to 17 on a Borg scale (Borg, 1982). This is in accordance with a heart frequency equalling the sum of the heart frequency in rest and 50–80% of the heart reserve frequency (i.e. maximum heart frequency minus heart frequency in rest) (Leurs et al., 2000). Each participant was asked to avoid co-interventions during the study period. Due to

Table 1
Exercise scheme of the supervised and home sessions (data are presented as frequency per week).

Week n°	Supervised sessions	Home sessions
1–3	3	0
4–5	2	1
6	1	2
7–18	1 booster session/3w	3