Promoting Movement Quality in Hip Osteoarthritis

Evaluation and treatment from the perspective of Basic Body Awareness Therapy

Aarid Liland Olsen

Thesis for the degree of Philosophiae Doctor (PhD)
University of Bergen, Norway
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UNIVERSITY OF BERGEN

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Scientific environment

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Content

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Abbreviations

ACR	American College of Rheumatology
ASES	Arthritis Self-Efficacy Scale
BARS-MQE	Body Awareness Rating Scale – Movement Quality and Experience
BBAT	Basic Body Awareness Therapy, movement awareness learning
BMI	Body Mass Index
COSMIN	COnsensus-based Standards for the selection of health Measurement INstruments
CI	Confidence Interval
EULAR	European League Against Rheumatism
EQ5D5L	EuroQol - measure of health status
HHS	Harris Hip Score
HOOS	Hip Osteoarthritis Outcome Score
JSW	Joint Space Width
MCII	Minimal Clinically Important Improvement
MDC	Minimal Detectable Change
NRS	Numeric Rating Scale
OA	Osteoarthritis
OARSI	Osteoarthritis Research Society International
PE	Patient Education
PGIC	Patient Global Impression of Change
r	Pearson correlation
r_s	Spearman correlation
RCT	Randomized Controlled Trial
SD	Standard Deviation
6MWT	Six Minute Walk Test

Abstract

Background

Osteoarthritis (OA) may have consequences for individuals' physical, social and personal functioning. In the physiotherapy modality Basic Body Awareness Therapy (BBAT), movement quality is promoted by movement awareness learning, and biopsychosocial as well as personal aspects of movement and health are implemented to support participants' insight into how they move and engage in their daily lives. Originating from BBAT theory and practice, the movement quality evaluation tool Body Awareness Rating Scale–Movement Quality and Evaluation (BARS-MQE) quantifies movement quality as observed and analysed by the physiotherapist (part 1), and invites the participant to describe immediate movement experiences (part 2).

Aims

The objective of the present project was to study the evaluation and promotion of movement quality from the BBAT perspective in persons with hip OA. The project includes four studies regarding I) experiences from participating in patient education (PE) and BBAT groups for persons with hip OA, II) movement experiences in the BARS-MQE evaluation, part 2, described by persons with hip OA, III) associations between movement quality, evaluated by the BARS-MQE, and recommended measures of function and health in hip OA, and IV) the effects on pain and functioning from participating in 12 weekly sessions of BBAT when added to PE.

Materials and methods

Multiple methodological approaches were applied. In connection with a pilot study of effects from PE and BBAT, personal interviews were conducted to explore the participants' experienced outcome from the interventions (Study I). Seven persons participated in PE, and five of them additionally participated in BBAT groups. The data were analysed qualitatively using Systematic Text Condensation. Based on experiences from the pilot study, a randomized controlled trial (RCT) of treatment effects in 101 participants was conducted, using ANCOVA analysis to compare differences in change between the intervention (PE+BBAT) and the comparison (PE

only) group (Study IV). Using data from the baseline assessments of the RCT, two studies of movement quality evaluated by the BARS-MQE were conducted. First, movement experiences verbalized by 35 persons as part of the BARS-MQE (part 2) evaluation were analysed using qualitative content analysis (Study II). Secondly, an explorative study of associations between movement quality scores (BARS-MQE, part 1) and measures that are commonly used for persons with hip OA was conducted, using correlation analysis of baseline measures in the 101 study participants (Study III).

Results

In Study I, the participants described aspects of the content and pedagogy in PE and BBAT that they perceived meaningful for their learning outcome. Central aspects were to receive trustworthy information from professionals and being supported by peers. When experiencing new possibilities for functional movement and becoming more aware of own needs, the informants described to also experience more well-being, functionality and self-management over time. In Study II, participants verbalized their immediate movement experiences as a part of the BARS-MQE evaluation. They provided insight into factors that influenced negatively on the way they moved, such as changed body perception, symptoms and compensational habits, and also described movement aspects that they became aware of in the BARS-MQE and perceived to be meaningful to practice, to obtain more healthy movement. Study III showed that movement quality was somewhat affected in the study sample, as compared to normative values. It was moderately associated with measures of physical capacity (Stairs test and 6MWT) and level of activity (UCLA), and weakly or not reflected in self-reported measures of problems with function and health (HOOS, EQ5D5L, ASES). In the main study, Study IV, we found no evidence that PE+BBAT was more effective than PE only on the primary outcomes; pain during walking (NRS) and function in activities of daily life (HOOS A). Movement quality (BARS-MQE) was, however, significantly more improved in the intervention group, and these participants reported more improvement in pain (p=0.03) and function (p=0.07) by the PGIC, than comparisons. In a per protocol analysis including 30 intervention participants who had attended to 10 or more BBAT sessions, we found differences in change on movement quality (BARS-MQE), self-efficacy (ASES pain), health (EQ5D5L VAS) and function (HHS), in favour of the PE+BBAT group.

Conclusions

This PhD project has shown that movement quality, evaluated by the BARS-MQE, was affected in many of the participants with hip OA, but with great variations. The movement quality scores were generally not well reflected in commonly used measures of function and health in hip OA, except for movement quality in walking. When focusing on movement experiences in the BARS-MQE, individuals with hip OA provided insight into experiences of movement challenges and resources. By participating in the BBAT and practicing the integration of functional movement aspects into their movement habits, they improved their movement quality significantly. The clinical impact of improved movement quality by the BARS-MQE score is still unclear, as it was not reflected in improvements on the hip-related measures used, including the primary outcomes in our RCT; pain during walking and ADL function.

Participants described experiencing PE and BBAT as beneficial for function and self-management on short and long term. However, the RCT did not show evidence that PE and BBAT in groups were more beneficial than PE alone. This may be due to the fact that 1) there was a ceiling effect on the primary outcomes, 2) not all participants demonstrated dysfunctional movement quality, 3) the majority of comparison patients were found to receive other physiotherapy, and 4) poor compliance in some intervention participants. We found that a minimum of 10 BBAT sessions was needed to obtain a satisfactory outcome.

List of publications

The thesis includes the following publications, referred to in the text by their Roman numerals.

I. Olsen AL, Strand LI, Skjaerven LH, Sundal M-A, Magnussen LH. Patient education and basic body awareness therapy in hip osteoarthritis – a qualitative study of patients' movement learning experiences. Disability and Rehabilitation 2017; 39(16): 1631-1638. doi:10.1080/09638288.2016.1209578

II. Olsen AL, Strand LI, Magnussen LH, Sundal M-A, Skjaerven LH. Descriptions of movement experiences in the Body Awareness Rating Scale – Movement Quality and Experience evaluation. A qualitative study of patients diagnosed with hip osteoarthritis. Physiotherapy Theory and Practice 2019; Jul 1:1-11. doi: 10.1080/09593985.2019.1636434.

III. Olsen AL, Magnussen LH, Skjaerven LH, Sundal M-A, Assmus J, Ostelo R, Strand LI. Movement quality evaluation and its correlation with recommended functional measures in hip osteoarthritis. Physiotherapy Research International 2020, May 24;e1848. doi.org/10.1002/pri.1848

IV. Olsen AL, Magnussen LH, Skjaerven LH, Assmus J, Sundal M-A, Furnes O, Hallan G, Strand LI. Basic Body Awareness Therapy improves movement quality, not pain and daily life activities in people with hip osteoarthritis: a randomised controlled trial. Submitted to Physical Therapy, September 2020.

Introduction

Prevalence and burden of osteoarthritis (OA)

OA is one of the most common musculoskeletal disorders and among the 10 strongest contributors to disability in high-income countries[1]. Due to ascending life expectancies, the proportion of persons with OA in the population is growing[2]. OA occurs in one or multiple synovial joints, is most common in hand, foot, knee, spine and hip joints, and is classified as primary (absence of a known cause)[3] or secondary (caused by joint injury or abnormalities)[4]. For the hip joint alone, the life-time risk of developing OA has been estimated to 25% in persons who live to the age of 85[5], with a prevalence of 6.1% in European countries[6], and 5.5% in Norway[7]. Although symptom severity tends to vary among individuals, the progressive nature of the disease commonly leads to gradually increased disability with personal costs as well as economic burdens on the individual and society[8-10]. Health care and indirect costs due to work loss and premature retirement are substantial[11], and even higher when the disease progression leads to hip replacement surgery[12].

Pathogenesis of OA

OA is historically referred to as "wear-and-tear" arthritis or age-related arthritis. According to the Osteoarthritis Research Society International (OARSI) definition[13], OA includes, but is not limited to a degeneration of cartilage tissue. Moreover, this chronic disease involves a dynamic process of tissue destruction and repair leading to cartilage degradation, bone remodeling and osteophyte growth[14]. Low-grade joint inflammation may occur as a reaction to cartilage breakdown products and debris, thereby hampering the process of repair and driving the process of degeneration[15-17]. It has been proposed that biomechanical factors, like un-physiological loading patterns, contribute to pathogenesis and disease progression in OA[18]. Building on a substantial body of research, OA is today understood as an active joint disease including mechanical, inflammatory and metabolic factors, rather than a passive cartilage wear-off.

OA diagnostic and classification

Individuals with OA commonly seek help for symptoms like pain, joint stiffness or functional limitations. For some, symptoms may be present long before structural changes are captured on radiographs[19]. Conversely, a large proportion of persons (up to 40%) with radiographic severe OA have reported to be symptom free[20]. It is due to such diversities that the American College of Rheumatism (ACR) recommend the combination of radiographic (presence of osteophytes, joint space narrowing) with clinical (hip pain, history, range of motion, morning stiffness, blood analyses) criteria in order to establish the correct diagnose and initiate appropriate treatment[21]. Assessing the disease severity by loss of cartilage, one of the two radiographic outcomes; joint space narrowing (JSN)[22] or joint space width (JSW)[23] is commonly used. Considering the normal hip JSW to be approximately 4 mm, hip OA severity based on JSW ≥ 3mm has been categorized as grade 0, 2.5-2.9 mm as grade 1, 1.5-2.4 mm as grade 2 and <1.5 mm as grade 3[24]. In a systematic review of radiographic methods, JSW less than 2-2.5 mm was found to be predictive for future hip replacement surgery[25]. The degree of radiographic OA severity is, however, only weakly associated with individuals' self-reported pain and physical function[26].

OA pain

The pain experience varies considerably among individuals with OA[27]. Typically, OA related joint pain is induced by physical activity in early stages and later progressing to be more constant during the day and/or at night[28]. Persons with OA of the hip typically present with pain around the great trochanter, in the groin, thigh or buttock areas, and some of them experience additional pain from the knee or lower leg[29]. Sudden flares with increased pain and stiffness may occur, - in some cases resolving after a few days and in other cases requiring additional treatment[30]. Joint inflammation may be a contributor to such sudden pain fluctuations[31,32], but may also be present as a chronic, asymptomatic process[33]. The intensity of OA pain is perceived unstable by the majority of individuals, many of them experiencing several episodes of increased pain monthly[34,35] or even daily[36]. The remodeling process in OA may involve bone changes with abnormal ossification and joint deformation that contribute to persistent pain during workload[37,38]. Similar to what has been found in other long-lasting pain conditions, the central nervous system may become hypersensitive in OA pain over time[39,40], and some individuals develop neuropathic-like symptoms with high pain intensity and widespread pain[41]. The personal experience of pain intensity in hip OA is associated with a number of factors, such as the person's educational level, life satisfaction and comorbidity, which underlines the importance of educating individuals for a best possible disease management[26].

Altered movement patterns in hip OA

Changes in movement characteristics are common for persons with hip OA and have been documented in several biomechanical studies. An example is gait, where persons with hip OA tend to utilize less of their hip range of movement as compared to healthy controls[42]. Analyses of gait patterns have shown reduced mobility also in the contralateral hip, as well as reduced stride length, changed intra-limb coordination patterns in the affected leg, and increased ankle mobility on both sides[43-46]. Altered activation patterns in the muscles include increased power production in the non-affected leg[47] and prolonged muscular activity in the affected leg[48]. This reduced ability to release muscle contractions around the affected hip during walking can play a role for several aspects of motor control, such as muscular power, postural stability and gait velocity[49]. Persons with hip OA have demonstrated a tendency to walk with wider steps and larger movements in the trunk[44,50], which has also been associated with postural instability[51]. A typical compensation for limited hip motion is the prolonged forward tilt of the pelvis[52,53], which potentially enhances the muscular imbalance around the lumbar spine, pelvis and hip.

Although pain avoidance may be a plausible explanation, the mechanisms behind altered movement patterns in hip OA are not fully understood. In a study including persons with mild to moderate hip OA, observed gait alterations were not found to be associated with pain[54], and also in later stages of the disease, abnormal patterns have been found to be associated with muscle weakness rather than pain[55]. From their descriptions of pushing themselves in the attempt to participate as usual at work and in social life[60,61], it is likely that persons with hip OA try to move in the most efficient way possible, even if it requires that they use more energy and neglect bodily signals of overload. There is also evidence of changed proprioception in hip OA, which may contribute to asymmetric loading patterns in hip OA[56]. Asymmetric loading over time may increase the risk of OA progression in the affected joint and OA development in other weight-bearing joints[57], which gives relevance to investigating therapies that specifically address movement habits and –quality in this group of individuals.

Living with hip OA

Individuals' experiences from living with OA have been described in several qualitative studies. Independent of objectively measured OA severity, their perceived health status has been found to be strongly associated with impaired physical function related to stiffness and muscular weakness[58,59]. Findings from a meta-ethnography of 32 qualitative studies showed that functional impairment in work performance and basic daily-life activities was a major source of individuals' concern[60]. Furthermore, they experienced that pain and fatigue were related to each other, and that incidences of increased pain gave rise to fear of further deterioration and negative beliefs about the future. As a consequence of symptoms and functional challenges, persons with OA have described experiences of undesirable shifts in their personal roles; from healthy to ill, from being independent to relying on help from the spouse or family, and from participating socially to withdrawing from social events[60]. With this, many of them struggle to maintain their self-image and identity.

Persons with OA who are of working-age have described their daily life as fragile due to an unreliable body and lack of control over sudden flare-ups[61]. From their stories, they might choose to down-scale or adjust their domestic and leisure time activities trying to save energy and be able to continue their working lives. Up to 40% of persons with OA suffer from fatigue[62], which is experienced to have substantial impact on their physical and social functioning[63]. Other persons have stated that unpredictable events of pain are emotionally draining and often result in withdrawal from social and recreational activities[64,65]. Reports from a large observational study (EPOSA) support such experiences, showing that the presence of OA explained a 47% increased risk of social isolation in older persons[66].

Treatment and management in hip OA

There is to date no cure for OA, but joint replacement surgery is offered to persons who experience a substantial loss of function and quality of life[22]. The procedure for total hip replacement (THR) is regarded safe and effective, but the implant commonly wears off over time (10-20 years)[67,68]. It is therefore recommended that younger persons postpone the procedure when possible, and that everyone who has symptomatic OA is offered therapies aimed to maintain or improve daily functioning and coping[69,70].

Like in most long-lasting conditions, the pain and symptoms in OA are subjective experiences that are modulated by environmental and psychosocial factors[27,71]. Acknowledging the close relationship between physical and mental well-being, it is recommended that health professionals address a broad specter of modifying factors like physical function, helplessness, depression, coping, self-efficacy and social support, in line with a biopsychosocial approach[72]. Self-efficacy, for example, has been found to be directly related to pain perception, level of physical activity and health-related quality of life in persons with OA[73,74]. Educational self-management programs can have some effects on self-management skills, pain, symptoms and function[75], and it is recommended to offer such programs alongside exercise and weight-regulation, for a best possible OA management[70].

Besides recommendations for patient education, strategies to address biopsychosocial aspects are scarcely described in OA physiotherapy guidelines[76]. Although there is a general consensus among physiotherapists to evaluate individuals with OA broadly and in accordance with the International Classification of Function (ICF), the recommended treatment modalities almost exclusively address factors in the ICF category Body function and structure, such as muscular strength, flexibility and physical fitness[76]. It is assumed that physiotherapeutic exercise that improve physical function may also have an indirect effect on psychosocial health factors, such as helplessness, depression, coping and self-efficacy[72]. In a recent qualitative study, physiotherapists confirmed that they did not regularly assess or address psychosocial factors in the treatment of persons with knee OA[77], which indicates that a biomechanical approach might still be dominant in the treatment for persons with OA. More research is needed to describe and investigate strategies to implement psychosocial aspects into physiotherapy for this group of people.

Physical exercise in hip OA

Due to disability, persons with OA tend to become less physically active over time[78] and are at higher cardiovascular risk than the general population[79]. Regular exercising is regarded to be beneficial to prevent comorbidity, and Public Health recommendations for physical activity have been found feasible and safe for persons with hip OA, with or without guidance from health care providers[80]. With the growing use of self-reported outcomes from non-surgical treatments, exercise and physical activity have been found beneficial also for symptoms and psychosocial health, and individualized exercise is currently recommended as a core treatment option for patients with hip OA[69,70]. There is also some evidence that, when added to patient education, 3 months of supervised exercise can postpone the need for hip replacement surgery, compared to patients receiving patient education only[81].

The impact of physical exercises on pain and functioning has been summed up in a Cochrane review[65] of quantitative and qualitative studies on OA. The findings confirmed that exercise, to some degree, can improve physical function, depression, pain and health-related quality of life. According to participants' own experiences, their outcome from exercising was strongly related to how the exercise program was delivered, namely that personalized guidance from an experienced practitioner was provided, with assurance of exercise safety and information about exercise efficacy[65]. In a more recent review, Goh et al.[82] showed that strengthening exercise can have moderate effects on pain and function in hip OA. However, improvements from exercise in knee and/or hip OA tended to peak around 2 months after the exercise started, and then gradually declined[83].

Compared to knee OA, effect sizes from exercise in hip OA have been found to be smaller, and the uncertainties of exercise effects greater[82,84]. This may explain why individuals with hip OA have been found with a higher risk of surgery within 7 years after treatment compared to individuals with knee OA[85]. The assumption that individuals with hip OA might respond somewhat different to exercise treatment than individuals with knee OA support the relevance of investigating physiotherapy interventions for persons with hip OA separately, and possibly also from new perspectives.

Since the systematic review of Goh et al, six articles have been published from RCTs investigating effects from exercise for persons with hip OA alone (Table 1). This was revealed from a literature search in the databases PubMed and Embase in July 2020. Steinhilber et al.[86] found that hip muscle strength was significantly improved after 12 weeks of exercising three times weekly. Secondary analyses of the same sample, conducted by Krauss et al.[87], showed that the improved strength had not resulted in improved gait parameters. A similarly weak relationship between strength training and performance was demonstrated by Bieler et al.[88,89], who found that Nordic Walking and progressive strength training were equally effective for improved hip muscle strength and hip range of motion, whereas only Nordic Walking was found to be effective for improving functional performance.

Table 1. Randomized controlled trials of exercise in patients with hip OA, 2017-2020

Author, year, design	**N, mean age, re-cruitment**	**Intervention, type, duration**	**Outcome measures**	**Results**
Steinhilber 2017 Three-arm RCT	N=210, 60 years, newspaper and out-clinic	60-90 min. supervised exercise (physical, social and theoretical elements) 1 x weekly, + home-training 2 x weekly, compared to placebo ultrasound (15 min 1 x weekly) and non-treated controls. 12 weeks.	Hip muscle strength (technical devices).	Significant differences in improved muscle strength between groups, in favor of the exercise group.
Bieler 2017 Three-arm RCT	N=152, 70 years, home-dwelling	1 hour progressive strength training 3 x weekly (2 supervised, 1 unsupervised) vs. Nordic walking 3 x weekly (2 supervised, 1 unsupervised), vs. unsupervised home-training. 4 months.	Chair stands (prim), Stair climb, 8-foot Up-and-Go, MOS, 6MWT,WOMAC, PASE, Task-specific self-efficacy, ASES, SF-36	Nordic Walking was superior for functional performance outcomes, level of activity, task-spec. self-efficacy and some of the SF-36 subscales.
Bieler 2018 Three-arm RCT, secondary outcome analyses	N=152, 70 years, home-dwelling	1 hour progressive strength training 3 x weekly (2 supervised, 1 unsupervised) vs. Nordic walking 3 x weekly (2 supervised, 1 unsupervised), vs. unsupervised home-training. 4 months.	Muscle strength and power (technical devices), ROM	No difference in change for muscle function or ROM between groups. Some significant improvements within all groups at 2, 4 and 12 months.
Østerås, 2017 Two-arm Pilot RCT	N=33, 63 years, seeking help for hip pain	60 min. 3 x weekly. High versus low intensity exercise. 8 weeks	VAS pain (prim) sit-to-stand, steps, HADS, TSK, stiffness, WOMAC	Tendency of improvement in both groups. No difference in change between groups.
Krauss 2020 Three-arm RCT, secondary analyses	N=210, 60 years, newspaper and out-clinic.	60-90 min. supervised exercise (physical, social and theoretical elements) 1 x weekly + home-training 2 x weekly, compared to placebo ultrasound (15 min 1 x weekly) and non-treated controls. 12 weeks.	Gait analysis using camera motion captures	No change in gait characteristics despite improved self-reported physical function and muscular strength.
Thompson 2020 Two-arm pilot RCT	N=31, 60 years, advertise-ment	60 min. 3 x weekly. Supervised exercise (aerobic and strength) + home-training. Controls: physiotherapy waiting list. 3 months	6 MWT (prim), WOMAC physical function, VAS pain	No significant difference in change between groups.

MOS = marching on the spot, 6MWT = six minute walk test, WOMAC = Western Ontario McMaster Universities Arthritis Index, ASES = Arthritis Self-efficacy Scale, SF-36 = Short Form, ROM = range of motion, VAS = visual analogue scale HADS = Hospital Anxiety and Depression Scale, TSK = Tampa Scale for Kinesiophobia.

Two pilot RCTs have since 2017 been conducted to investigate effects of exercise in hip OA. Østerås et al.[90] found no difference between high- versus low exercise dosage on pain, physical capacity and self-reported function, but a tendency of improvement in both groups. Thompson et al.[91] compared the outcome of 3 months of exercise to no treatment, and found no difference in change between the groups on physical capacity, pain or self-reported function.

From previous research, we have identified two trials investigating the effect from exercise on gait kinematics in hip OA[87,92], both of them showing negative results. The authors suggested that, to induce improved gait characteristics, a relevant amount of task-specific exercises related to gait should be implemented in the therapy.

Summing up, individuals with hip OA are likely to benefit from exercise therapy regarding pain and function on short term, especially if it involves strengthening exercise. However, there is currently no evidence that traditional exercise is effective for changing dysfunctional movement patterns in hip OA. Also, we do not know whether improved movement quality is associated with improvements in pain and function.

Movement quality – multiple perspectives

Optimal movement function is one of the core concepts in physiotherapy[93]. There are, however, great diversities in the way physiotherapists understand and describe the phenomenon of movement quality[94]. Different perspectives may determine which features of movement quality are in focus. From a biomechanical perspective, movement quality can be understood as the agreement between a persons' movement performance and specified standards for normality regarding body alignment and muscular activation around specific joints[45,95,96]. An expanded perspective on movement quality is applied in the Standardized Mensendieck Physiotherapy Test (SMT), where the individual's cognitive self-awareness is embedded in the movement quality evaluation[97]. In the SMT, the whole-body movement co-ordination is evaluated, including how the respiration is integrated and how persons transfer verbal instructions into movements.

A further expansion of perspectives on movement quality has been described in a study investigating statements from expert physiotherapists treating movement disorders in the field of long-lasting health problems[98]. In this study, a Movement Quality Model was developed to visualize the content, and movement quality was described as a general and unifying phenomenon that includes biomechanical, physiological, psycho-social-cultural, and personal perspectives on human movement. This study also presents definitions of identified elements and aspects of movement, to describe how movements are performed. Unique for the model is the description of psychological and personal aspects, such as how the emotional drive is expressed in the movement, and also the awareness of the self, the "I am" and the personal way of moving when relating to the surroundings and other people[99]. This multi-perspective model has previously been used to describe and interpret outcomes from motor learning in post-stroke rehabilitation, where movement quality is a central aim[100]. Movement elements and aspects visualized in the Movement Quality Model are specifically addressed in the physiotherapy approach Basic Body Awareness Therapy[101] and the evaluation tool Body Awareness Rating Scale – Movement Quality and Experience[102], which are under study in this PhD project.

Basic Body Awareness Therapy (BBAT)

A physiotherapy approach that is structured to involve the whole moving person in evaluation and treatment, is the Basic Body Awareness Therapy (BBAT). The methodology of BBAT builds on movement awareness learning as a platform for promoting movement quality in daily life movements[98,103]. Movement awareness is understood as the attentiveness to sensations, perceptions and feelings that are related to nuances in the way one moves[104]. According to BBAT theory, life strain and disease may affect the way a person moves and uses the body, often in a restrictive way[105]. A negative process may develop, characterized by gradually diminished contact with the body and its movements, less nuanced use of the body, weakened beliefs in own capacities related to daily-life settings, and compensational movement strategies. BBAT is therefore focused onto stimulating contact with and awareness of oneself as a whole person, advancing movement potentials that may have become hidden.

Through small, simple, mindful and gentle movements, the participants are guided to get in contact with their body and experience nuances of the movement itself, rather than striving for a correct performance[103]. As the awareness of own movement habits and potentials grows, the participants are supported to practice and implement movement aspects that they find meaningful for more well-being and functionality, and they are encouraged to search towards more functional movement quality[103,106]. Implementing the pedagogical steps described in the Movement Quality Learning Cycle[103], BBAT is focused to stimulate a constructive attention to the body[107], meaning to experience the body as a carrier of movement potential, rather than a problem[108].

In BBAT theory, movement is understood as a fundamental way of being and acting in the world[109], and movement quality is defined in accordance with the Movement Quality Model, embracing biomechanical, physiological, psycho-socio-cultural and existential perspectives of human movement[98]. From a biomechanical perspective, the BBAT treatment therapy is aimed to enhance sensitivity to the form of the movement and its spatial parameters following anatomy, such as relating to horizontal, vertical and diagonal axes, center versus periphery, moving up-down, back-forth and with rotation. Aspects from a physiological perspective include rhythm, elasticity and springiness within the body, integration of the breathing as it adjusts naturally to activity and rest, and involvement of the moving person as a whole. Movement aspects from a psychological perspective are related to the person's intention, emotional elements and use of energy in the movement, as well as intentional clarity and mental presence in the movements, i.e. "I turn", "I walk", "I move together with you". The awareness of shifts between high and low energy is stimulated in various movements, either individually or in interplay with another person, with adjustment of energy to smaller versus larger movements, or slower versus faster rhythm. From a personal perspective on movement, the self-awareness is central in BBAT movements, and the person is encouraged to explore and respect own boundaries and become aware of own preferences and movement possibilities. Participants are not given a fixed answer on how to move, moreover are they guided to explore and integrate movement aspects that they find meaningful and useful for own health and well-being, for thereby gradually master more functional movement on their own terms. Aspects from the four described perspectives are implemented in all BBAT movements[103].

BBAT is offered in individual and group therapeutic settings. When leading a BBAT group therapy, the physiotherapist aims to create a platform for interpersonal learning, and utilizes therapeutic group factors to enhance the learning outcome, as described in psychotherapy[110]. The group pedagogy is structured to facilitate movement exploration rather than performance, thus minimizing any element of competition. Being included in a group of equals, for example other persons with hip OA, participants may experience a sense of belonging and become enabled to accept their situation. When moving together with others, participants practice psychosocial factors like being close and distant, respecting others and being respected, taking care of one-self and others and being taken care of, touching others physically and being touched. In this social group setting, participants may become aware of how they perceive and respond to interactions with others, and develop functional strategies for work, family and social life.

Integrated in all BBAT sessions is the therapeutic talk, where participants are encouraged to verbalize and reflect upon their immediate movement experiences. The ability to find words to describe own movement experiences in a here-and-now situation is regarded important to individuals who, in daily-life settings, may struggle to define and express their needs. Later in the learning process, the therapeutic talk is also used for conceptualization of new insights about movement quality in ordinary activities at home, at work or in social settings. It also provides an opportunity for participants to ask questions related to their condition, for example the interpretation of bodily, emotional and social perceptions that occur in relation to the on-going process of change.

To ensure a transference of learning outcome from the BBAT session into daily-life settings, the participants select movements from the BBAT program that they find meaningful, and practice those movements regularly at home. As all BBAT movements are extracts from daily-life movements; lying, sitting, standing and walking, experiences from movement practice can be directly implemented into ordinary daily activities, and the participants are encouraged to do so. As a part of the therapy, they are to take notes from their movement practice in a log-book, describing the movements as well as their own movement experiences and reflections. These notes provide a possibility for the person to reflect on and better understand the own learning process, and are for personal use only.

The outcome from BBAT has previously been investigated in several RCTs. Individuals in psychiatric outpatient care have demonstrated improved self-efficacy, sleep, attitude towards the body, and physical coping resources[111]. Persons with eating disorders have showed improved body satisfaction, body attitude, control of drives and quality of life[112], while persons diagnosed with major depression have demonstrated improved symptoms of depression[113]. For individuals with chronic whip-lash associated disorders, BBAT has demonstrated more improvement in pain and social functioning, compared with traditional exercise therapy[114]. In a small study of young females with idiopathic scoliosis, who were treated with bracing and traditional exercise, the participants demonstrated greater improvement in thoracic curve magnitude, body symmetry and trunk deformity when additionally participating in BBAT[115]. Finally, persons with fibromyalgia have demonstrated significantly more reduced pain when BBAT was added to their usual treatment[116]. The previous research shows that BBAT can be beneficial for physical and mental aspects of health in various long-lasting conditions. The rationale for trying out BBAT in persons with hip OA was to promote contact with and integration of the hip in more fluid and rhythmical movement. We hypothesized that the BBAT movement awareness learning program would support persons with hip OA to improve their movement quality and, indirectly, be beneficial for pain, function, health and self-efficacy.

Movement quality evaluation from the BBAT perspective

Two movement quality evaluation tools, a Swedish and a Norwegian, have been developed within the BBAT methodology. The Swedish, Body Awareness Scale

Movement Quality and Experience (BAS MQ-E) was developed from the original BAS[117]. The current version includes 23 movement items representing everyday functions like walking, stomping and stepping up onto a chair[118]. The score is based on three factors of observation; stability in function, centering/breathing and relating/awareness[119], as well as a self-report questionnaire on body experiences, symptoms and coping strategies[118].

The Norwegian evaluation tool Body Awareness Rating Scale – Movement Quality and Experience (BARS-MQE), which is used in Studies II, III and IV of this PhD project, was developed from the original BARS – Movement Harmony[120-122]. BARS-MQE consists of two intertwined parts. In part one, the physiotherapist guides the individual and observes, evaluates and scores movement quality in 12 movement items extracted from the original BBAT program[106]. The movements represent daily life functions; lying, sitting, standing, walking and relational movement[102]. The evaluation of movement quality is focused on how postural stability, breathing and awareness are integrated in the movements and expressed in movement aspects like the form and path of the movement, flow, elasticity, rhythm, intentionality and unity. The whole moving person is in focus, rather than specific body regions. Part two is a phenomenological inquiry following each of the 12 movements; "How was this movement for you?", where the individual is invited to describe immediate movement experiences. BARS-MQE part two is not scored. Measurement properties of the BARS-MQE are further presented under Outcome Measures.

Unique for BARS-MQE is its health-directed process orientation that includes the promotion of functional movement quality within the evaluation setting. Using a specific strategy, movement pedagogy and vocabulary[103,123], the physiotherapist invites the person to come in contact with, explore, experience, become familiar with, adjust and potentially develop more functional movement quality through 5-10 repetitions of each movement item. With this, the BARS-MQE evaluation captures the person's involvement and adaptability to a change towards more functional movement habits when being invited and guided by the physiotherapist.

Patient education (PE) in Scandinavia

Educational programs for self-management have been offered to persons with OA for at least three decades, with the purpose to encourage them to take an active role to improve life with their condition, rather than improving the condition itself. In a systematic review of studies of effects from self-management programs published between 1990 and 2013, it was concluded that the direct effects from such programs alone were small[75]. However, as shown in systematic reviews including persons with knee OA, the inclusion of exercise into the self-management program may increase its beneficial effects[124,125]. In line with these findings, programs that combine patient education with specific OA exercise have been developed and rolled out in physiotherapy practice in the Scandinavian countries. The Swedish "Better Management of Patients with Osteoarthritis", was launched in 2008. It consists of two to three theoretical group sessions and a practical session with introduction to an individualized exercise program, followed by 6 weeks of exercising at home or in a supervised group twice a week, and an individual physiotherapy visit after 3 months. Around 13.000 persons with hip OA participated in this program between 2008 and 2016 and demonstrated improvements in pain, health status and self-efficacy, medication intake, daily pain, willingness to undergo surgery and fear-avoidance behaviour[126]. A similar program was initiated in Denmark in 2013; "Good Life with osteoarthritis in Denmark", consisting of three theoretical sessions of education followed by 6 weeks of neuromuscular exercise (NEMEX) twice a week at home or in supervised groups, and an individual physiotherapy session after 3 months. Persons with knee or hip OA who participated in this program have demonstrated improved pain, physical function, physical activity and quality of life, as well as reduced sick leave and intake of painkillers[127]. The Norwegian "Active with osteoArthritis" (AktivA) was initiated to enhance the implementation of treatment guidelines, and provided an educational program combined with recommended exercise, for use in physiotherapy practise. The program consisted of three theoretical sessions of education, followed by 6-12 weeks of supervised exercise twice a week. Persons with knee and hip OA who participated in this program between 2016 and 2018 demonstrated improved pain, general and health-specific quality of life, and physical activity levels up to two years after starting the program[128]. The theoretical sessions of education in all of the three mentioned programs are focused onto promoting a dialogue with the participants, describing the OA disease and discussing treatment options, and giving advice on benefits from optimal loading, weight regulation and physical activity/exercises. The PE intervention offered in the present PhD project is based on the theoretical content of AktivA.

Pilot study

A pilot study with a multiple case design was conducted to explore the feasibility and outcome from Patient Education (PE) and BBAT groups for individuals with hip OA[129]. Sixteen persons who had been considered for hip replacement surgery were advised to try out PE first, optionally followed by BBAT in a group. Seven patients accepted to participate and attended a 2-hours patient education seminar. Thereafter, two of them preferred to participate in self-administered physical activity, while 5 volunteered for 12 weeks of BBAT in a group. All participants complied well and attended the full BBAT program, except one, who stopped after 7 weeks, due to other health problems. All the patients in the BBAT group, except one, reported significant reduced pain during walking after 4 months, and this improvement was maintained after 10 months in three of the patients. All the patients, except one, reported improved function after 4 and 10 months. In lack of comparison patients, we do not know whether the results from this study are due to natural variability in the course of OA or effects from the treatment. However, the fact that improvements generally were maintained also after 10 months, indicated that new insights from PE combined with the movement learning outcome from BBAT had become implemented and had an effect on the participants' daily-life activities. In connection with the multiple case pilot study, a separate qualitative interview study of the participants' experiences from PE and BBAT was conducted and included in this PhD thesis (Paper I).

Based on the results of improved pain and function found in the pilot study, and supported by the participant's own statements in interviews, PE and BBAT seemed to have a positive influence on mental and physical aspects of movement and health that are affected in hip OA. The treatment hypothesis in BBAT for this group of individuals is that they gain insight into their movement habits and potentials, and involve the hip in more functional movement strategies over time. With access to, and use of, more nuanced movement strategies, they might experience less pain during walking and be able to move with more ease in daily life activities. With a sense of mastering movement more, they might be empowered to engage in activities and social participation using less energy-demanding strategies, and be more able to handle symptoms constructively.

Aims

General aim

The overall purpose of this thesis was to study the evaluation and promotion of movement quality, as described within the physiotherapy modality Basic Body Awareness Therapy (BBAT), in the context of hip OA. In four separate studies, participant's experiences and statements were explored qualitatively, and movement quality scores and treatment effects from a BBAT intervention focused on movement quality were investigated quantitatively.

Specific aims

I. To explore qualitatively how individuals with hip OA described their experiences from participating in PE and BBAT groups (Paper I).

II. To explore qualitatively how individuals with hip OA described their immediate movement experiences and reflections when exploring 12 daily-life movements in the Body Awareness Rating Scale – Movement Quality and Experience (BARS-MQE) evaluation (Paper II).

III. To explore quantitatively whether and how movement quality, evaluated by the BARS-MQE, was associated with commonly used health measures in hip OA; physical capacity tests and self-reported pain, function, self-efficacy and health (Paper III).

IV. To investigate the short-term outcome of BBAT in addition to PE compared to PE only in people with hip OA, reflected in self-reported and physiotherapist-administered evaluation of health and function. The main outcomes were pain during walking and function in activities of daily life (Paper IV).

Material and methods

Design

Study I. A qualitative interview study of individuals' short (3 months) and long-term (10 months) experiences from participating in PE and BBAT.

Study II. A qualitative study of individuals' verbalized movement experiences and reflections when exploring movement elements and aspects in the Body Awareness Rating Scale – Movement Quality and Experience (BARS-MQE) evaluation at baseline.

Study III. A cross-sectional, explorative study of associations between baseline scores on movement quality assessed by BARS-MQE and those of commonly used measures of function and health in hip OA.

Study IV. A randomized controlled trial examining the supplementary treatment effects from BBAT added to PE, compared with PE only, in persons with hip OA at six months follow-up.

Participants

Study I. The pilot study included 7 persons with hip OA. In the period January to February 2014, 16 persons were evaluated by an orthopaedic surgeon for hip replacement surgery, but were recommended to try out conservative treatment first. Seven (3 women and 4 men) agreed to participate in a pilot study investigating short- (3 months) and long term (10 months) outcomes and experiences from PE (n=7), optionally followed by BBAT in a group over 12 weeks (n=5). *Inclusion criteria*: Women and men with primary OA according to the American College of Rheumatology Clinical Criteria[21], living within a reasonable travelling distance to the treatment location. *Exclusion criteria*: Other known major physical or mental problems or disease that precluded movement training and participation in an educational program, known drug abuse, not speaking or understanding the Norwegian language, pregnancy 5-9 months.

Study II. This qualitative study included interview data at baseline from the 35 first patients enrolled in the randomized controlled trial (RCT), Study IV. The criteria for inclusion and exclusion were the same as in the pilot study (Study I). The participants were recruited from the orthopaedic out-patient clinic at a university hospital. Some had been considered for surgery, but were recommended by the orthopaedic surgeon to try out conservative treatment first. Others had been referred from their general practitioner in primary health care to the hospital clinic solely for participation in PE. Persons with verified hip OA and assigned to PE received written information about the study and were to respond by telephone message to the daily project manager if they were willing to participate or needed more information about the study.

Study III. All the participants (n=101) of the RCT (Study IV) were included in this quantitative study of baseline assessment data, collected before the intervention. The average age was 63 years (SD 10.8) and 80% were women.

Study IV. The RCT included 101 persons with hip OA. In the period October 2015 to January 2019, 176 persons were invited to participate in the RCT. Seventy-three did not respond to the invitation, while two accepted to participate, but withdrew before randomization. The remaining 101 persons were included in the study and randomly allocated to an intervention group (n=51) or a comparison group (n=50). At 6 months, 14 persons were lost to follow-up, and 1 person was excluded due to comorbidity (rheumatic joint disease) unknown at inclusion. Eighty-six participants were, accordingly, included in the analyses of change, 41 in the intervention group and 45 in the comparison group.

Randomization

Before attending the PE, individuals who fulfilled the inclusion criteria and consented to participate in the study were invited to an assessment session. After signing a written informed consent, they were assigned a trial ID number. They filled in questionnaires and were examined by the daily project manager regarding physical capacity and movement quality in accordance with the study protocol[130]. A computer-generated block randomization schedule (blocks of 4) was used to allocate participants to an intervention group or a comparison group. A research coordinator had prepared opaque envelopes including allocation to groups (A or B). Immediately after each PE seminar, envelopes were handed out to study participants by a researcher otherwise not involved in the assessments or interventions, following the numbers of a randomized list. From the information sheet in the envelope, participants in the comparison group were recommended to follow advice given in the PE course concerning self-training and/or guided physiotherapy in primary health care, while participants in the intervention group were offered to participate in 12 weekly sessions of BBAT in primary health care, and provided with the therapist's contact information. Allocation to study groups was kept concealed from assessor and other study collaborators until the analyses of the RCT data were conducted and discussed, and was not revealed before the data collection at 1- year follow-up for all participants was completed.

Data collection

Study I. Personal interviews were conducted and audiotaped 4 and 10 months after the initial PE seminar. The interviews lasted 30-40 minutes and were conducted at the hospital, in connection with the follow-up assessments of the pilot study. Two participants were not able to attend the 10 months follow-up assessments and interviews.

Study II. The whole BARS-MQE evaluation (part 1 and 2) at baseline was audiotaped in the first 35 participants of the RCT. Each session lasted about 45 minutes. The participants were invited to verbalize their immediate experiences after each of the 12 BARS-MQE movements by the question: "How was this movement for you – can you describe?". Movement experiences from the movements (lying, sitting, standing, walking and relational) were transcribed for analysis.

Study III. Demographic data, observed and scored movement quality, physical capacity test scores and self-report questionnaires on perceived function and health were registered using the web-based program InfoPad at baseline assessment (all the included instruments are described in detail below). The same physiotherapist conducted all assessments. An orthopaedic surgeon measured joint space width at baseline on radiographic images. Data from all included participants (n=101) were analysed.

Study IV. Demographic data and test scores of movement quality, physical capacity and self-report questionnaires on perceived function and health were registered in InfoPad at baseline (Study III) and test scores at 6 and 12 months follow-up. Only data from 6 months follow-up was examined and reported in this PhD project. Eventual concomitant physiotherapy in the intervention period was also registered in InfoPad by the participants. The same assessor, blinded to allocation, conducted all assessments. One participant was excluded, and 14 were lost to follow-up assessment. Data from the remaining 86 participants were included in the analysis of short-term effects after 6 months.

Interventions

Study I. Seven individuals with hip OA participated in 2 hours of PE, offered by a specialist physiotherapist. Five participants chose to take part in the following 12 group sessions of BBAT, offered by a physiotherapist in primary care. Each session lasted 90 minutes and consisted of movement practice and reflective talk. The participants were to practice at home and implement movement aspects into daily life settings.

Study II. No intervention was given prior to the data collection, which took place at baseline in connection with the BARS-MQE evaluation and in accordance with the RCT protocol.

Study III. No intervention was given prior to the data collection, which included the full assessment at baseline, in accordance with the RCT protocol.

Study IV. All the participants completed 3.5 hours of PE focusing on hip and knee OA, offered by an orthopaedic surgeon and a specialist physiotherapist from the university hospital. Immediately after PE, the patients were randomly allocated into intervention and comparison groups. Both groups were encouraged to follow advice given in the PE, including to be physically active and consulting a physiotherapist when needed. The intervention group was additionally offered 12 group sessions of BBAT, held once a week and lasting 90 minutes. The sessions included movement practice, reflective talk and advice for self-training and implementation of movement aspects into daily life settings.

Patient Education (PE)

In the pilot study, the PE seminar was led by a specialist physiotherapist and lasted for two hours. The PE program was inspired by the Norwegian educational program AktivA[131], but was organized as one 3.5 hours seminar instead of three single sessions. All physiotherapists involved in the PE intervention had participated in a 9-hours postgraduate AktivA course and with updated and evidence-based knowledge about OA management. The PE also included a lecture by an orthopaedic surgeon, and the participants had the possibility to bring forward questions concerning pharmacological and surgical treatments. Participants' sharing of own experiences with OA was encouraged. Emphasis of PE was put on describing the dynamic nature of joint structures and the importance of optimal loading, and giving advice on weight bearing and physical activity, adjusted to functional limitations and pain. Pharmacological and surgical treatment options were presented, and exercises addressing typical movement problems in hip OA were demonstrated. Shock-absorbing materials in shoe soles and weight reduction in overweight were recommended. Participants were advised to be physically active and to obtain guidance from physiotherapists in primary health care if needed.

Basic Body Awareness Therapy in groups (BBAT)

The BBAT groups were led by a physiotherapist in primary care who was educated and experienced in the use of BBAT. Specific strategies for promoting movement quality through movement awareness in daily life movements; lying, sitting, standing, walking and relational, were applied. Therapeutic group factors like interpersonal learning, support and relationships were integrated in the therapy[110]. The specific movement pedagogy of BBAT was aimed to promote a movement awareness learning process that is described and visualized as a cycle of seven steps; making contact with, exploring, experiencing, integrating, creating meaning, mastering and conceptualizing/reflecting upon movement aspects for more functional movement strategies[103]. The participants were guided as a group and individually within the group, and the therapist moved together with the patients as a role-model while guiding verbally. Integrated in all movements were aspects to address functionality of the hip within whole-body movement co-ordinations. The participants were to attend 12 weekly group sessions of BBAT, each consisting of about 70 minutes of guided movements followed by 20 minutes of reflective talk in the group or between participants. They were encouraged to practice movements regularly at home between the sessions, and to implement experienced movement aspects into daily life activities and settings. As part of the treatment, they used a log for personal notes on movement experiences and reflections. Generally, 2-4 new study participants were allocated to the running BBAT group every month, meaning that the group consisted of new and old members at all times, to transfer learning.

Outcome measures

Physical capacity tests

Three tests of physical capacity were conducted in the RCT. In the *Chair Test,* the participant repeated raising from a chair and sitting back down as fast as possible, and the number of repetitions during 30 seconds was counted. High test-retest reliability has been demonstrated (Intra-class correlation (ICC) coefficient = 0.85)[132], and 2.0-2.6

repetitions are regarded a clinical important improvement[133]. In the *Stairs Test,* the patient ascended and descended 18 steps three times, and was instructed to walk as fast as possible, but within safe limits. The time used was measured in seconds[134]. In the *Six Minutes' Walk Test (6MWT)*, the patient was instructed to walk as far as possible during a course of 6 minutes, without running. A distance of 15 meters was measured and marked, and the patient walked back and forth around cones that were placed on the marks. The distance walked was measured in meters. High test-retest reliability has been shown, minimal detectable change (MCD) being 50.2 meters[132].

Movement quality evaluation

Movement quality was evaluated using the *Body Awareness Rating Scale–Movement Quality and Experience (BARS-MQE),* including 12 movement items. A quiet room was prepared, and the participants were informed orally about the purpose of the evaluation. Through about 4 minutes and 5-10 repetitions for each movement, the participants were given time to explore, experience and reflect on how they moved. The observed and analysed movement quality in each movement was scored on an ordinal scale from 1 (dysfunctional movement quality) to 7 (functional movement quality), according to described criteria[98] and registered through InfoPad. The same therapist conducted all evaluations. The BARS-MQE sum score ranges from 12 to 84. High test-retest reliability has been shown (ICC=0.96, MDC being 3.3 points)[102]. BARS-MQE has been found to correlate moderately with most subscales of the Short-Form Health Survey (SF-36) and with the General Perceived Self-Efficacy Scale (GPSES) in persons with musculoskeletal conditions, and to discriminate between these persons and people who regard themselves healthy and well-functioning.

Self-report questionnaires

Pain during walking was assessed by the *Numeric Rating Scale (NRS),* scale 0 (no pain) -10 (worst pain possible). Excellent test-retest reliability (ICC = 0.95) has been reported for use in persons with knee OA[135]. A change ≥ 15.3 mm on a 0-100 scale is considered clinically important in hip OA[136,137].

Perceived difficulty with physical function over the previous week was assessed by the *Hip Osteoarthritis Outcome Score (HOOS),* containing questions of five domains; pain (P) - 10 items, symptoms (S), - 5 items, Activities of Daily Life (A), - 17 items, sport and recreation (SP) - 4 items, and hip related quality of life (QL) - 4 items[138,139]. Each item was answered on a Likert scale (no, mild, moderate, severe, extreme) and scored from 0-4. The sum score of each domain was transformed by the InfoPad program to a normalized 0-100 scale, where 0 indicates extreme problems and 100 no problems. HOOS has shown high test-retest reliability (ICCs = 0.78 to 0.91)[138].

The *University of California Los Angeles activity score (UCLA)* was used to assess the self-reported level of physical activity during the last month on a 10 point ordinal scale from totally sedentary to participating regularly in high intensity physical activities[140]. Criterion validity of UCLA has been indicated as it correlated strongly with steps per day as recorded by pedometer[141]. Excellent test-retest reliability has been reported (Kw = 0.80, 95% CI = 0.70 to 0.90), and UCLA has been found able to discriminate between active and inactive individuals with hip OA[140].

The *Arthritis Self-efficacy Scale (ASES)* is a questionnaire about self-efficacy regarding pain, symptoms and physical function in persons with arthritis[142]. The sub-categories Pain and Symptoms consists of 5 and 6 questions, respectively, each to be answered on a 5-point Likert scale (1-5)[143]. The sum-score (worst-to-best) of sub-category Pain ranges 5-25 and of Symptom 6-30. Convergent validity of ASES has been demonstrated, as it was moderately correlated with the General Self-Efficacy Scale (r ranging from 0.35 to 0.45)[144]. High test-retest reliability has been reported, r=0.87 for pain and 0.90 for symptoms[142].

The *EuroQol (EQ-5D-5L)* is a generic health index comprising a five-part questionnaire and a visual analogue self-rating scale[145]. The five dimensions concern mobility, self-care, usual activities, pain/discomfort and anxiety/depression, each scored on a five-point ordinal scale from no problem to extreme problems. After the participant filled out the questionnaire, an EQ index was calculated, ranging from 0.0 (worst health) to 1.0 (best health). The EQ VAS was recorded by the participants on a vertical, visual analogue 0-100 scale with the endpoints 'worst/best imaginable health state'. Convergent validity of the EQ5D5L has been demonstrated, as it correlated strongly with the Oxford Hip and Knee Score, and test-retest reliability has been reported in patients referred for hip or knee replacement, ICCs for the 5 items ranging from 0.61 to 0.77[146].

The *Harris Hip Score (HHS)* is a multi-dimensional tool to assess hip disability, and combines the person's self-reported pain and function with the physiotherapist's observation of movement range. In our study, the participants' responses to the questionnaire were recorded by the assessor. HHS has demonstrated excellent test-retest reliability[147]. It has been found suitable for evaluating change in hip function after rehabilitation treatment, and increased scores by 16.8 points have been found to be clinically important improvement in hip OA[148].

Patient Global Impression of Change (PGIC) was used to collect the participants' own impression of change in pain and function after 6 months. They marked their response on a 7-point ordinal scale: 1 very much worse, 2 worse, 3 somewhat worse, 4 no change, 5 somewhat improved, 6 improved, and 7 very much improved[149].

Procedure for testing

In the baseline assessment, demographic data, NRS scores for pain and HHS scores were collected first, using the web-based program InfoPad. Thereafter, the BARS-MQE, Chair Test, Stairs Test and 6MWT were performed. Finally, the participant sat alone by the PC and filled in the ASES, EQ5D5L, HOOS, and UCLA questionnaires, the assessor within reach in case of technical problems. In the follow-up assessment at 6 months, only the HHS scores were collected before the movement quality evaluation, the physical tests and self-reported data. PGIC and concomitant physiotherapy were registered as part of the self-report questionnaires in Infopad.

Sample size

Study I and II. The appropriate sample size for the qualitative studies was considered in the light of the expected information strength in the obtained data[150]. Seven persons with hip OA were included in the pilot study and were informants in Study I. They demonstrated satisfactory variability regarding age, gender and work status. A larger number of informants was not regarded necessary, as information strength was obtained by a focused dialogue in one-to-one interviews, and the baseline interviews were supplemented by follow-up interviews 6 months later.

The setting that was used for data collection in Study II, a physiotherapy evaluation, was untraditional for qualitative research and did not include a prolonged dialogue. Therefore, in lack of evidence from the literature to reason for the appropriate sample size, we included a relatively high number of participants (n=35) to secure variance and richness in our data.

Study III and IV. The sample size for Study IV was calculated on the basis of previous research reporting on our primary outcomes; NRS for pain during walking and HOOS subscale A. Based on studies using NRS for pain[136,137], the minimum important improvement was 15.3 points on a 0-100 scale, equivalent to 1.5 points on the 0-10 scale used in our study. Assuming a between-participant standard deviation of change of 30 points and a type I error risk of 0.05, the required sample size with 80 % power was calculated to 44 participants in each of the two groups. Allowing for a 15% drop-out, a total of 100 participants was required. As to HOOS A, referring to power calculation of a previous study[151], 74 participants were needed to detect a clinically relevant change of 10 points (SD ± 15, power =0.80 and $\alpha = 0.05$) in persons with hip OA. A total of 100 participants were, accordingly, a sufficient sample size for both of our primary outcomes in Study IV.

All participants in the RCT were included in our study of correlations between baseline scores of the BARS-MQE and the other measurement instruments (Study III). For validation studies in which correlation coefficients are calculated, a minimum of 50, but preferably 100 participants is recommended[152]. Hence, the number of 101 participants included in the RCT was regarded sufficient.

Analyses

Study I. Tape recorded interview data were transcribed verbatim and analysed using Systematic Text Condensation (STC)[153]. This method is developed by Malterud and is inspired by phenomenological analysis. In the first step of the analysis, preliminary themes were identified by repeated reading of the full text. In the next step, meaning units from the text were identified, coded and sorted into categories, and the relevance of the preliminary themes was discussed and re-considered. The content of the new code-groups was then re-written into more abstract condensates. In the last step, new concepts and descriptions were developed from the condensates, and validated by consulting the raw data for confirmations and possible contradictions. Three main themes about learning outcomes on short and long term were identified and presented, illustrated by quotes from the informants.

Study II The data material for this study consisted of relatively short descriptions from most participants, but rich descriptions from all 35 informants taken together. Obtained in the BARS-MQE physiotherapy evaluation setting, the data reflected the immediate here-and-now experiences, more or less free of preconceptions and judgement. As this was the first study to explore the movement descriptions given by individuals being evaluated by the BARS-MQE, we chose to apply content analysis with its possibility of examining both the manifest (literally present in the text) and/or the latent (implying a deeper meaning) content of the text[154]. After completing the transcription and reading through the material, it became clear that most of the informants' verbalizations carried meaning to be analysed in-depth, and our analysis generally followed the steps for qualitative content analysis, as described by Graneheim and Lundman[155]. Meaning units were identified, abstracted and coded, with considerations to the overall context. Most of the text was directly relevant, hence a condensation of the text was hardly necessary. The codes were sorted into sub-categories in a process of repeated rounds of comparison and discussion, as well as returns to the raw data for validation. Two interrelated main categories, each with three sub-categories were identified. In the final step, the underlying meaning of the sub-categories were formulated and presented with illustrative quotes from the raw text.

Study III Demographic and test data at baseline were examined using descriptive statistics. Distribution normality was explored by histogram inspection. Correlation analyses of Spearman and Pearson were found to demonstrate similar values, hence indicating linearity in continuous and categorical variables. Giving the most precise estimates, Pearson's coefficient was chosen to present and interpret our findings. Analysis of correlation between measures were performed using IBM SPSS 25[156] and *R* [157] statistical packages.

Study IV

Descriptive statistics were used to describe participant characteristics at baseline. Fifteen participants were lost to follow-up, and excluded from the analyses of difference in change. Differences at baseline between participants lost to follow-up and those included in analyses of effects were investigated using independent *t*-tests. Normal distribution was explored by histogram inspection. Changes from baseline to follow-up within each of the groups were examined by paired samples t-tests. From independent samples *t*-tests, standardized confidence intervals were used to calculate effect sizes of change between groups. Analysis of covariance (ANCOVA) was applied to examine whether changes from baseline to follow-up were influenced by the intervention offered. An intention to treat analysis included all participants that completed the follow-up assessment at 6 months (n=86). A per protocol analysis included the comparison group and patients in the intervention group who had completed at least 10 BBAT sessions (n=75). Patient Global Impression of Change was registered at 6 months follow-up, and differences between the two groups were examined using independent *t*-tests. A responder analysis was conducted, based on minimal detectable change (MDC) values as anchors. Responder values were defined as the mean change on NRS for pain during walking, HOOS A and BARS-MQE scores in participants who reported "Some improvement" in pain and function, respectively, on the PGIC. The statistical packages IBM SPSS 25[156] and *R* 3.5.1[157] were used.

Ethics

All participants in our study were encouraged to be physically active and seek physiotherapeutic advice when needed. Participants allocated to BBAT intervention did not receive any restrictions regarding other types of treatment in the intervention period, but they were encouraged to prioritize the movement awareness practice in the intervention period. This may have resulted in reduced exercise activity for participants who would otherwise have attended traditional exercise interventions instead of BBAT. Participation may also have prolonged the time to hip replacement surgery for those who had severe OA already at baseline.

As movements included in BBAT are gentle and adjusted to each individual, we expected no adverse effects or harm from the movement program. All participants received written information about the project, including potential benefits or inconveniences, as well as their right to withdraw from the project at any time. The protocols for the pilot study and the RCT study were approved by the Norwegian Committees for Medical and Health Research Ethics (number 2013/2252/REK and 2015/1392/REK, respectively), and the studies were conducted in accordance with the Helsinki Declaration. The collection of data through InfoPad is approved by the Norwegian Data Protection Authority.

Summary of results

Study I. The results from this qualitative study describe experiences from participating in the interventions, described by 7 persons with hip OA. All participated in PE, and five of them additionally volunteered to participate in 12 weekly sessions of BBAT. Three main themes were identified from the interviews by means of Systematic Text Condensation. Theme 1), *Becoming motivated and involved* reflected experiences of encouragement and motivation related to understanding the disease better and being supported by professionals and other group members. In Theme 2), *Movement awareness learning*, the participants described becoming aware of and practicing movement aspects that they found meaningful for alleviating symptoms and improving daily functioning. Theme 3), *Movement and disease in a long-term perspective*, reflected the participants' experience of increased self-awareness and of taking better care of themselves at follow-up, 10 months after baseline. With a sense of mastering basic movement principles, they felt empowered to handle daily life challenges in more functional and energy-economical ways.

Study II. The results from this qualitative study reflect individuals' immediate movement experiences, verbalized and described as part of the BARS-MQE evaluation, part 2. Responding to the short question after each of the 12 movements; "How was this movement for you – can you describe?", 35 participants revealed their direct movement perceptions and described how their movement strategies were influenced by sensations from the moving body. Two interrelated categories of movement awareness were identified. Category 1) *Experienced movement challenges*, included three sub-categories; i) Lack of contact, ii) Movement changed by symptoms, and iii) Compensational movement habits. Category 2) *Movement components promoting well-being*, included three sub-categories; i) Integrating balance, breathing and awareness into movement, ii) Small, simple, soft and safe movements, and iii) A taste of own movement resources for daily life. From the results, the BARS-MQE evaluation provided a platform for individuals with hip OA to describe how and why their movement habits had changed, and also identify movement aspects that they found meaningful for more well-being. Their embodied insight may complement the physiotherapist's evaluation and clinical reasoning for a following rehabilitation process.

Study III. In this exploratory study of 101 participants diagnosed with hip OA, mean scores on movement quality evaluated by the BARS-MQE were found to be lower (less functional) than normative values. However, there were great variations, implying that some participants had good functional movement quality, while the movements in others could generally be described as rather unstable, staccato, a-rhythmical and fragmented. The BARS-MQE sum score was found to be moderately associated (r = 0.30 to 0.42) with measures of physical capacity and activity, like walking (6MWT), climbing stairs (Stairs Test), and self-reported level of physical activity (UCLA). Self-reported pain, function, self-efficacy and health were weakly or not associated (r = 0.07 to 0.29). Movement quality in walking (BARS-MQE item 12) was found to be associated with all the other measures included in the study. The results indicate that movement quality to a limited degree is reflected in commonly used measures of function and health considered important in hip OA. Therefore, in physiotherapy that is focused on the participants' movement patterns and –habits, movement quality should be evaluated separately by a measure like BARS-MQE.

Study IV. This RCT, evaluating the effectiveness of BBAT, included 101 persons with hip OA. We found no difference in change between the groups on the primary outcomes; pain during walking (NRS) and function in activities of daily life (HOOS A) at 6 months follow-up, neither in intention-to-treat nor in per-protocol analyses. In intention-to-treat analysis, only movement quality (BARS-MQE) was found to improve more in the intervention group than in the comparison group, with a large effect size (0.84) of difference. This difference in change was somewhat larger in the per-protocol analysis, in which the intervention group (including only compliers of BBAT) additionally demonstrated more improvement in health (EQ5D5L VAS) and function (HHS), and less worsening in self-efficacy ASES pain) than the comparison group, with moderate effect sizes (0.36 to 0.53) of difference.

Intention to treat analysis at follow-up showed that the participants in the intervention group reported more improvement on PGIC for pain than the comparison group (p=0.03) and tended to report more improvement also on PGIC for function (p=0.07). For participants who reported "Some improvement" on PGIC, there was a mean improvement of 1.0 point on NRS for pain during walking, 7.4 points on HOOS A and 3.5 points on BARS-MQE. The proportion of participants who showed such clinically important change was found to be similar in the two groups, providing supplementary evidence of no difference in change between the groups on the primary outcomes. For movement quality, the difference between groups was supported, as 41% in the intervention group and 14% in the comparison group showed a clinically important improvement.

Discussion

Main findings

The overall purpose of this thesis was to study the evaluation and promotion of movement quality, as described within the physiotherapy modality Basic Body Awareness Therapy (BBAT), in the context of hip OA, including the effects from BBAT on pain and function. We found in an initial qualitative study that participants with hip OA experienced patient education (PE) followed by 12 weeks of BBAT to be beneficial for improved function and symptom management. In another qualitative study, we provided insight into direct movement experiences of individuals with hip OA, including perceived resources and challenges that influenced the way they moved. Further, we have found that movement quality, evaluated by the BARS-MQE, on average was somewhat affected in our participants, as compared to normative scores, but with great variability. Movement quality was, however, not highly reflected in measures of function and health considered important in hip OA. Applying the strong design of an RCT, we found that adding BBAT to PE did not result in more improved pain during walking and function in activities of daily life, being the primary outcomes. Movement quality was, however, more improved, and the participants' impression of change in pain and function was stronger in the intervention group. Also, participants who complied with the therapy, completing at least 10 BBAT sessions, demonstrated additional improvements of self-efficacy, health status and function, showing that movement quality can have an impact on other health indicators in people with hip OA.

Introducing BBAT in hip OA

The pilot study leading up to this PhD project was the first to investigate the BBAT approach in persons with hip OA[129]. As this long-lasting condition frequently affects individuals' movement patterns as well as their psychosocial health, BBAT was considered a relevant approach since both aspects are addressed in this therapeutic strategy, and beneficial effects from BBAT on physical and mental aspects of health had been demonstrated in other long-lasting conditions. The pilot study showed that all participants, except one, improved in pain during walking (NRS) and all, except two, improved in daily life function (HOOS A). Additional beneficial outcomes were found for function (HHS), health status (EQ5D5L) and hip range of motion. As the improvements tended to be sustained also at 10 months follow-up, the learning outcome from the therapy seemed to have been implemented in the participants' movement habits and had an effect on their daily functioning. The promising results needed, however, to be challenged in a larger study with a stronger design.

Effects from BBAT on primary outcomes

We had expected that improved movement quality from BBAT, characterized by more postural stability, free breathing, appropriate use of energy and integration of the hip into daily life movements, would indirectly be beneficial also for pain and function, like we found in the pilot study. In contrast to our hypothesis, however, our RCT did not demonstrate evidence for improvement in pain during walking (NRS) and function in daily life activities (HOOS A), being the main outcomes. One possible explanation might be the different characteristics of participants of the two samples, with more severe test scores in the pilot study. The inclusion criteria for the RCT were wide and did not specify a minimum level of symptoms and functional problems required to participate in the study. This might have allowed for an unintended large heterogeneity with increased variance of scores that, consequently, weakened the statistical power of our analyses. From the baseline data, a considerable number of participants presented with rather good scores (ceiling effect) related to the primary outcomes measures (Tables 2 and 3) and were, consequently, not likely to demonstrate improvement.

Table 2. Distribution of NRS baseline scores in participants included in analyses of change (n=86).

NRS pain in walking	Intervention group n (%)	Comparison group n (%)
0-1	3 (7)	6 (13)
2-3	14 (34)	8 (17)
4-5	20 (49)	24 (53)
6-7	4 (10)	4 (9)
8-9	0 (0)	3 (7)
10	0 (0)	0 (0)
Total	41 (100)	45 (100)

Table 3. Distribution of HOOS A baseline scores in participants included in analyses of change (n=86).

HOOS A score	Intervention group n (%)	Comparison group, n (%)
0-20	0 (0)	0 (0)
21-30	1 (2)	1 (2)
31-40	0 (0)	4 (9)
41-50	5 (12)	4 (9)
51-60	8 (19)	6 (12)
61-70	8 (19)	7 (15)
71-80	8 (19)	8 (18)
81-90	9 (22)	10 (22)
91-100	2 (5)	5 (11)
Total	41(100)	45(100)

In studies of symptom responses, like in the present study, OARSI guidelines recommend that participants should have a minimum pain score of 4 on NRS at inclusion, to permit detection of change[158]. As it turned out, 31 participants (17 in the intervention group and 14 in the comparison group) in our study demonstrated scores lower than 4 on the NRS for pain during walking (Table 2). Regarding the HOOS A, 26 participants (11 in the intervention group and 15 in the comparison group) scored higher than 80 points (Table 3), which is about the average score in healthy persons of the same age (82 points for women and 83 points for men)[159].

Such a high proportion of participants who were rather unlikely to improve on the primary outcomes, might to some extent explain why we were able to demonstrate only small mean improvements in both study groups, and no difference in change between the groups. To ensure that all participants had a potential for changing to the better or worse, cut-off points for the primary outcomes should have been added to our inclusion criteria.

In previous studies showing effects from exercise on pain and/or function (the primary outcomes in our RCT), the described exercise programs mostly included an element of strengthening exercises[151,160-166]. Although many of the BBAT movements involves weight-bearing and activation of muscular synergies around the hip and trunk, muscular strength is not particularly addressed in BBAT. The relationship between strength and improvement in pain and function in people with hip OA is, however, not well explained. Several of the previous studies demonstrating effects on pain and function included participants who were already scheduled for hip replacement surgery, such as the studies by Ferrara et al.[160], Villadsen et al.[151], and Hermann et al.[161]. The scores on pain and function in those study participants was poorer than what we found in our RCT, and they might have had a larger potential for improvement. However, Fernandes et al.[166], Jukahoski et al.[165] and French et al.[164] included participants with moderately affected physical function, more similar to those included in our study, and demonstrated effects from exercise on function by the Western Ontario McMaster Universities Arthritis Index (WOMAC). In those studies, no significant effects on pain (VAS or WOMAC) was demonstrated on short term.

Another factor that might have influenced our findings is the time between baseline and follow-up. Due to the rather long follow-up period of 6 months in our study, we were not able to capture effects that might be stronger immediately after the BBAT intervention, and possibly followed by decline. On the other hand, as BBAT is focused on the integration of new movement habits, we had expected that the effects from the therapy would gradually develop over time, from experiencing, learning and adaptation to new ways of moving. For comparison, Svege et al.[167] showed that pain during walking (VAS) was insignificantly improved from exercise after 4 months, but improved further over a period of 10 and even 29 months. Likewise, Jukahoski et al.[165] found that, although physical function was not significantly improved at 3 months, the improvement increased to be significant at 6 and 18 months. The fact that our intervention participants, with a commonly progressive OA disease, did not decline in pain and function over a period of 6 months, might indicate that the treatment was somewhat beneficial. It remains to be seen in a planned study of long-term (1 year) effects, whether BBAT in may have induced improvements in our study participants that were small on short-term, but later developed to become more significant.

Concomitant physiotherapy in the comparison group might be another explanation why the difference in change between groups was small in our RCT. Participants in the comparison group received, from ethical reasons, no restrictions regarding physiotherapy. However, they registered in InfoPad whether, and to what degree, they had received physiotherapy in the community in the study period. As it turned out, 26 (58%) of the comparison participants attended physiotherapy between baseline and 6 months follow-up, on average 17 therapy sessions each. Thirteen reported having contacted a registered AktivA physiotherapist. This might be considered a positive effect from participating in PE, indicating that the participants had become motivated for non-surgical treatment. However, although we have no knowledge about the type of therapy given, we assume that this considerable volume of physiotherapy has had some beneficial effects on the participants' function and health, and thereby reduced the differences in change between the groups.

Movement quality scores (BARS-MQE) in relation to other measures in hip OA

In Study II, we examined the relationship between movement quality by BARS-MQE and a battery of measures that are recommended for use in hip OA. We found that movement quality was moderately associated with measures of physical capacity (Stairs test, 6MWT) and level of activity (UCLA) (r = 0.30-0.43), and weakly or not reflected in most of the other measures (Chair test, HOOS, EQ5D5L, ASES, HHS, NRS) (r = 0.07-0.29). Similar results were shown in a study investigating measurement properties of the Swedish movement quality evaluation, BAS MQ-E, for use in persons with hip OA[119], showing that movement quality was moderately associated with physical activity (6MWT and HOOS SP) and weakly or not associated with self-reported quality of life (SF-36) and function (HOOS P, S, A and QL). An explanation for the weak associations between movement quality and the self-reported measures may be that the BARS-MQE and the BAS MQ-E are generic tools, developed to evaluate individuals' general movement quality, regardless of diagnose or condition. With a broad and general evaluation, they might not reflect hip-specific problems, as they are defined in the measures of pain, health, self-efficacy and function that were included in the present study. An exception was movement quality in walking, as evaluated in the BARS-MQE movement item 12, which was found to be associated with all the other measures (r = 0.21-0.43), mostly with a stronger correlation than the BARS-MQE sum score. Movement quality in walking was also found to be moderately associated with pain during walking (r = 0.31), being one of the primary outcomes. From the results in Study III, we have not been able to demonstrate strong associations between the way individuals with hip OA move, and their hip related health problems, at least when evaluated by the BARS-MQE. The impact of movement quality in this group of individuals is therefore still unclear. However, from the participants' own descriptions of concerns regarding asymmetrical weight-load (Study II), movement quality seemed to play a role in their daily life. They described that movement in hip OA was related to high use of energy and effort, muscular tension and blocked breathing. In future research on movement quality in hip OA, it might be suggested to include health aspects like fatigue, quality of sleep and coping for evaluation of the participants' ability to balance between activity and rest. Furthermore, the measurement of hip range of motion might contribute to evaluate their muscular elasticity.

For the sake of interpreting our findings in our study of correlations between movement quality and the other included measures of function and health in hip OA (Study III), the International Classification of Function (ICF) may be used as a framework. The ICF was developed to promote a multidimensional understanding of function and disability[168], and is utilized by physiotherapists for multiple purposes, among those for selecting appropriate evaluation instruments[169]. The ICF model identifies three main constructs of function; Body function and Structure (Impairment), Activity (Activity Limitations) and Participation (Participation restrictions). Ideally, a measurement instrument assesses only one of these constructs, and only when they do not overlap, is it possible to interpret correlations between constructs correctly[170]. We postulate that the BARS-MQE, being based on observed movement quality, is a construct of movement performance and can be organized in the ICF model as a function of Activity (Figure 1). A strong relationship to the category Personal Factors might also be assumed, as the BARS-MQE score includes evaluation of the person's ability to be present in the situation and adapt to movement guidance. Attempting to organize the other instruments used in our RCT into corresponding ICF categories (Figure 1), we found that previous reports are inconclusive as to whether instruments measure single or multiple health outcomes as classified by the ICF. In a consensus study, experts regarded the Harris Hip Score and the EQ5D5L to measure Impairment as well as Activity Limitations[170]. Furthermore, it has been suggested that the HOOS subscales measure different constructs, with some overlap for the subscales Sport/recreation and Activities of Daily Life[171]. Finally, is the content validity of the ASES poorly documented, and it is debated whether this instrument measures individuals' actual function rather than their beliefs about abilities to function, as was intended[172]. Based on the mentioned reports, Figure 1 illustrates the instruments used in this study and their corresponding ICF constructs.

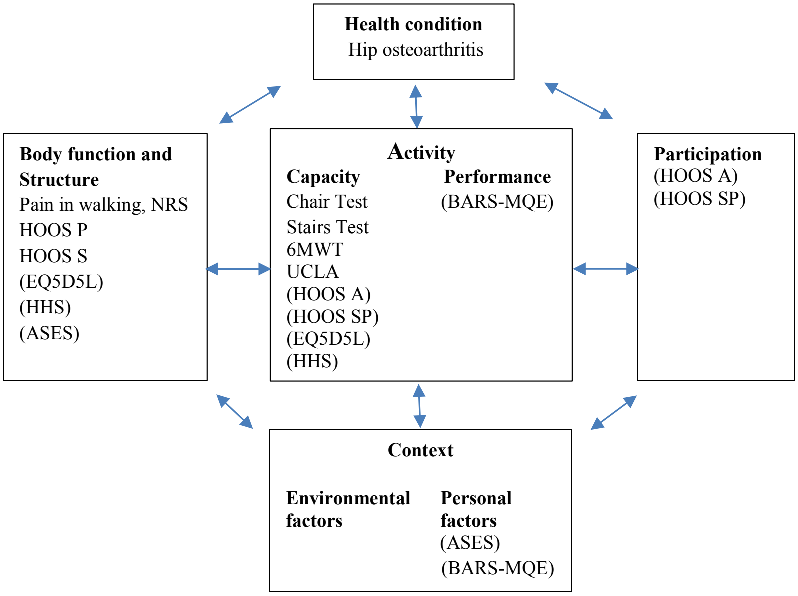

Figure 1. Overview of instruments and corresponding ICF constructs in a modified model.

Instruments in brackets are suspected to assess overlapping constructs. From this modified ICF model, the BARS-MQE, Stairs test, 6MWT and UCLA are organized within the same ICF construct, which resonates with our findings of moderate associations between movement quality and those tests of physical capacity and level of activity (Study III). Being the only instrument to be organized as a construct of performance, however, the BARS-MQE evaluation of movement quality might complement the commonly used measures of health and function in hip OA.

Interpreting movement quality (BARS-MQE) change scores

In our RCT participants, the average movement quality score was lower (46.6 points, range 27.0-60.0) at baseline than what previously has been shown in persons who reported themselves to be healthy and well-functioning (55.4 points, range 38.0-75.5)[102]. However, the ranges of scores were somewhat overlapping and indicate that some of the participant had rather good functional movement quality, despite their hip OA. This is in line with results from a previous study showing that a subgroup of individuals with hip OA remained well-functioning over at least 6-7 years, and did not develop movement compensations[173]. The average improvement of 5.1 points by the BARS-MQE in our intervention participants was higher than the minimal detectable change of 3.3 points that has previously been calculated in a group of people with long-lasting musculoskeletal problems[102]. It is of clinical interest that compensational movement habits, or consequences from those, improved to such a degree that it was observable in the movement quality evaluation, and that around 50% of the participants experienced improvement in pain and function by the PGIC (Study IV). However, we cannot draw a clear conclusion about the impact that improved movement quality had in our participants diagnosed with hip OA, as it was not reflected in improvements by measures that are validated for use in this group of people. There might be aspects of function and health that are related to movement quality or other functional aspects that were not investigated in this study.

Movement awareness in hip OA

In Study II, we gained insight into the way movements were experienced and described by the participants. The participants expressed being aware of, and striving to avoid, compensational movement in their daily life, being worried that asymmetry, limping and over-loading the non-affected leg etc., might do harm to the body over time. They stated that compensational movements gradually developed into new habits, in spite of efforts made to move "normally". The mechanisms behind altered kinematics in hip OA are not fully understood, and pain seems to be only weakly associated with such changes[54,174,175]. There is some evidence that, regardless of origin, abnormal movement patterns in the pelvis and trunk may be maintained and driven by muscle weakness around the hip, rather than pain[55]. This resonates well with our informants' statements of movement compensations not necessarily being related to pain avoidance, but also to stiff and tense muscles. They described that their attempts to normalize movements were challenged by a need to prioritize efficiency over quality in daily activities and by changes in body perception and motor control. These experiences might reflect previous findings of neurological involvement in hip OA; peripherally by altered proprioception[56], and centrally by structural changes in the brain[176]. Changes in body perception have also been found in other long-lasting musculoskeletal conditions. Perception of the painful area in long-lasting low back pain has been found to be inaccurate or even lacking[177], and patients with rheumatic disease have described to experience the body as fragmented, bended or distorted in size and shape[178]. The participants' experiences of beneficial effects from BBAT in Study I may be related to an improved contact with the body in the slow and mostly pain-free BBAT movements, and to a change towards a normalization of their body perception.

Although physical activity and exercise might be beneficial for neuromuscular function, traditional exercise programs have so far not been effective for improving gait parameters in hip OA[87,92]. A reason for this may be that exercises commonly are selected for high specificity rather than variability, meaning that they activate specific muscles in suitable body positions, rather than stimulate more general muscular synergies in various positions. Outcomes like muscular strength, flexibility and endurance are not specifically aimed for in BBAT, but a certain effect on muscular function might be expected, as the BBAT movements are aimed for promoting a balanced muscular tension and use of energy, as well as the activation of muscle synergies in the whole lower limb in standing movements. From the participants' own descriptions, they had experienced ways to find their postural balance and moving with more ease and confidence in their daily life activities after the BBAT intervention (Study I), which may be related to improved muscular interplay and more appropriate use of energy in relation to the task.

Movement awareness and self-awareness

The focus in BBAT is to enhance individuals' movement awareness, meaning their sensitivity to physical, mental and relational aspects of moving in daily life[105]. Increased awareness of the body may be considered a negative development if it is focused on symptoms and accompanied by catastrophizing, whereas persons who are sensitive to somatic signals and process those in a constructive, non-judgemental manner are less prone to distress and anxiety[107]. Such an accepting, resource-oriented awareness is integrated in the BARS-MQE evaluation as well as the BBAT practice.

From the results in Study I, participants from the BBAT intervention had experienced to gradually learn how to define and master the body and its boundaries, and to identify and deal with every-day situations that might be challenging for their hip. Their statements of "daring to try out movements and activities" and "functioning more and more in things that matter" indicate that they experienced a growing ownership of the body and its capacities. Their descriptions support the understanding of human movement as a behavioural expression, dynamic and variable in accordance with the person's perception and cognition, rather than a merely biomechanical function[179,180].

Methodological considerations

Study design

This PhD thesis as a whole meets the central premise of a mixed methods design, which is to apply and draw inferences from both quantitative and qualitative data[181]. The purpose of using this design was to form a nuanced picture of the phenomena under study, which was the evaluation and promotion of movement quality from the perspectives of BBAT, including the effects from BBAT on pain and function in hip OA. The quantitative studies allowed for statistical analysis, and offered strategies to reduce bias in our investigations of correlations and treatment effects. Complementing the quantitative studies, the qualitative studies contributed to understanding the context or setting in which the data was collected, bringing forward the participants' own movement experiences as well as their perceived outcome from the therapy.

Qualitative research, studies I and II

The qualitative studies were anchored in phenomenological philosophy and aimed to explore, analyse and describe lived experience[182,183]. Phenomenological research does not imply a search for causalities, but is aimed to reveal aspects of lived experiences that are perceived meaningful by individuals[153]. The studies were conducted in a rehabilitation setting and included persons who had sought help for health problems related to their hip OA. The phenomenon of health may not be the same for everyone, moreover it is shaped by the individual's perception of meaning and coherence[184]. The participants' own descriptions of their learning outcome and their movement perceptions in a health perspective were therefore considered a highly valid source of information. In Study I, semi-structured personal interviews were conducted after the PE+BBAT intervention (3 months) and at follow-up (10 months), aiming for descriptions from individuals' experienced learning outcome on short and long-term. The interviewer had not been involved in the conduct of the study had not met the informants before the first interview at 3 months follow-up. This was regarded a strength, as the informants might have felt more free to describe all kinds of experiences, including negative ones, to a person who had not been involved in the study interventions or assessments. In Study II, open questions were asked in the inquiry of immediate movement experiences in the BARS-MQE evaluation, with the purpose to study the participants' embodied movement experiences in a here-and-now perspective. The evaluation was conducted before the randomization procedure of the RCT, hence the participant and the assessor were blinded to the future study group allocation. It is likely that informants in Study II adopted descriptive words from the physiotherapist's guidance and used those when responding to the inquiry of movement experiences, especially individuals who by nature found it difficult to express themselves. This probability was taken into account and handled by analysing the latent content of the text as well as the literal words[155].

Quantitative research, studies III and IV

Study III included the baseline data of participants with hip OA who were enrolled in an RCT. A cross-sectional design was applied to explore associations between movement quality, being a novel measure in hip OA, and measures that are well-documented for use in this group of people. A strong correlation is not to be interpreted as evidence of causality between two measures, but means that high scores on one of them implies high scores on the other, with a similar variability of scores within the population under study[152]. The design in Study III allowed for a first exploration of whether and how movement quality was affected in the study participants, and whether BARS-MQE movement quality scores reflected other health aspects that are regarded important for persons with hip OA. A further investigation of movement quality in a longitudinal perspective, would be to explore associations between change scores in the BARS-MQE and the other measures included in this study.

A randomized, controlled trial (Study IV) is regarded the strongest study design for investigating treatment effects in a sample[185]. The randomization procedure promotes an equal distribution of confounding factors across groups and renders the treatment intervention as the most likely cause for the observed outcome. We recruited participants who were assigned to hospital out-patient PE, to ensure that all had updated knowledge about their disease and about benefits from physical activity and exercise, as recommended in international guidelines[69]. From ethical reasons, the participants in the comparison group could not be asked to withhold from exercise and physiotherapy during the intervention period, rather motivated to the opposite through PE, and accordingly, we were not able to compare BBAT to a true control group of participants receiving no treatment.

Subjects

All the participants in the pilot and the main study were diagnosed with primary hip OA, which was verified by the general practitioner in primary care or the orthopaedic surgeon who referred them to the patient education course. The inclusion criteria did not include any restrictions regarding the participants' symptoms and function, and aimed to enrol participants that are commonly seen by physiotherapists in primary care with regards to age, gender and disease severity. As a result, demographic and baseline test data showed great heterogeneity. The mean joint space width was 1.5 mm and indicated rather severe radiographic hip OA[24], while the mean scores on the HOOS subscales were better (6-25 points higher) than those found in individuals scheduled for hip replacement surgery[161]. The mean walking distance by the 6 MWT was about 170 meters shorter than the average distance demonstrated in healthy persons aged 55-75 years[186], but the variation was great (range 210-804 m). From the baseline scores, our participants seem to represent a wide spectrum of persons with hip OA in need of health care regarding age, radiographic severity, symptoms and level of functioning, which strengthens the external validity of the study. Different subgroups might, however, have shown different outcomes of the intervention given.

Interventions

Patient education

It was not within the scope of our study to explore the effects from participating in PE only, but based on participants' experiences in the pilot study (Study I), we expected that also participants in the RCT would find the PE informative and motivating for being physically active. We offered this program to all study participants to secure that they had the same, updated knowledge about their disease and its current treatment options. Offered as a single intervention or in combination with supervised exercise, PE programs with a content similar to the one offered in the present study has previously been found to maintain or slightly improve patients' selfreported pain and function[166,187,188]. In those studies, the PE program consisted of 3-4 single sessions of about one hour's duration, and an individual follow-up session a few months later. To reduce inconvenience, some participants having long traveling distances, we organized a half-day seminar instead of several single sessions. The advantage of this was that more people were able to participate, usually 8-10 persons each time. A possible disadvantage is that the learning outcome might have been reduced, as compared to multiple sessions in which the main messages could be better learned and understood.

BBAT groups

The physiotherapist who led the movement practice was qualified and experienced in BBAT. The BBAT program was developed and described in a protocol before the project started, and the sessions followed the same pedagogical structure and aim. The therapist's choice of movements and learning goals for the group was, however, continously adjusted to the participants' process and progression. The BBAT group intervention was offered at the same location for all participants and mainly by the same therapist, which promoted safety and familiarity as well as close interpersonal relationships among participants and therapist. Within the mentioned frame of personal adjustments and therapeutic processes, we find it reasonable to assume that all participants in the intervention group received a similar treatment.

New participants were randomly allocated to the running BBAT group every month, after they had participated in PE. Despite our efforts to inform private practitioners about the newly established PE course, fewer patients than expected were referred, especially during the first year. This resulted in slow recruitment and small BBAT groups, which may have influenced on the therapy outcome. According to the physiotherapists who led the BBAT groups, the number of participants was as low as 2 or 3 at some occasions, and the intended positive influence from interpersonal support and sharing of experiences became limited. New participants might not have benefited from hearing descriptions and reflections from those who had already practiced BBAT for a while, regarding their movement experiences and how they have implemented movement aspects into daily life settings. Another factor that we did not control for, was the participants' self-training between the BBAT sessions. The participants made a verbal contract with the physiotherapist that they would practice movements regularly at home and search to implement movement experiences while carrying out daily activities. These activities may have been reflected on and followed up in the clinical talk at the end of each BBAT session. We did, however, not request a report from the participants' home training, hence the full volume of BBAT movement training among our participants is not clear.

Outcome measures

The choice of measurement tools for the RCT was influenced by several factors. We aimed to include measures that were well-documented for use in hip OA. In the AktivA-initiative, physiotherapists had agreed on a battery of instruments that they would use to build up a data registry and thereby be able to investigate and monitor the outcome from the AktivA program. We decided to generally use the same assessment instruments. This choice was supported by the Osteoarthritis Research Society International (OARSI)[189] in their recommendations for conducting clinical studies in

OA, published shortly after the plan for our RCT was completed. All measures of function and health used in this study are listed in the OARSI guidelines, except for Harris Hip Score and the Basic Body Awareness Rating Scale – Movement Quality and Experience. Being frequently used by clinicians to classify OA severity, Harris Hip Score was included in our protocol, and it has recently been found to be a valid outcome measure for rehabilitation interventions in hip OA[148]. The evaluation tool BARS-MQE was included as it quantifies movement quality, being the mechanism behind the expected outcomes in our RCT.

As the BBAT intervention is directed towards functionality in daily life movements, we regarded the HOOS A an appropriate measure for capturing and reflecting relevant changes from the intervention. Likewise, we expected that if movement quality was shown to be improved by BBAT, it would also lead to improved muscular function and elasticity around the joint, and thereby result in reduced pain during walking (NRS). This is why we chose NRS and HOOS A to be our primary outcomes. In our study, the participants were asked to report their pain intensity during walking over the last week, but many of them expressed having difficulties to decide on a single number, as their pain intensity during walking varied and depended on factors like the time of day or the intensity of their activities/work. To help our participants to score, we could have asked them to report their pain during walking immediately after performing the 6MWT, as has been done in a similar study examining effects from patient education and exercise[167]. The 6MWT setting might have offered conditions that would be equal for all participants, as well as a concrete here-and-now perspective on pain that, consequently, could have provided more precise NRS scores.

At the time when the present RCT was planned and developed, we were not able to find evidence of validity for the included tests of physical capacity (Chair test, Stairs test and 6MWT). It has come to our knowledge, that similar performance tests recommended by OARSI (Sit-to-stand, stair-climb and fast-paced walk), recently have been found with poor construct validity and responsiveness for use in hip OA[190]. The researchers argue that the mere timing of activities neither captures degrees of impairment nor changes in the performance quality over time, and therefore does not represent individuals' actual daily life impairment. Future research should take this into consideration.

In addition to the hip OA related measures of function and health that were included in the pilot study, the BARS-MQE was included in the RCT as a tool to describe changes in movement quality, being the mechanism that we expected to induce improved pain and function in our participants. The BARS-MQE is strongly related to the BBAT therapy, as the 12 movements included in the evaluation may also be a part of the treatment program[121]. The close relationship between therapy and evaluation can be considered a strength for clinical practise, as the findings from movement quality evaluation can be directly implemented into the movement practice. Used in an RCT, however, it can be argued that this close relationship is a weakness, because the participants in a BBAT intervention group must be assumed to have practiced exactly the same movements that are later evaluated and scored. BARS-MQE was therefore not chosen as a primary outcome in our RCT, but was included in the evaluation protocol as an indicator of whether or not it was possible to improve movement quality in individuals with hip OA, who were expected to have developed compensational movement patterns. Furthermore, the qualitative part of the BARS-MQE (part 2) offered a possibility to capture and study the participants' movement experiences, being the aim of Study III.

Participants lost to follow-up

The validity of results from clinical trials is strongly related to an appropriate sample size, and participants lost to follow-up should therefore be accounted for[191,192]. In our study, 15 (14.9%) participants were lost to follow-up and therefore not included in the analyses of difference in change between the groups. Due to this exclusion, it can be argued that we did not conduct a true intention-to-treat analysis, and that we have not been able to investigate the effects of BBAT in a real life situation[193]. This is to some degree true, as we lost data from 3 participants in the intervention group who dropped out because they would rather participate in more vigorous exercise. For the remaining participants who were lost to follow-up, we assumed that the data was missing at random, meaning that the drop-out process was neither dependent on the outcome nor the intervention under study[193]. We examined the validity of this assumption by comparing the baseline variables of included participants (n=86) with those of participants lost to follow-up (n=15), calculating potential differences between the groups (Table 4, unpublished results).

Table 4. Demographic and test variables at baseline for participants included in analysis of difference in change between groups, and participants lost to follow-up.

Variables	Included in analyses n=86 mean (SD), min-max	Lost to follow-up n=15 mean (SD), min-max	Difference mean, p-value for indep. t-test
Demographic variables			
Sex; female, n (%)	67 (78)	13 (87)	
Age, years	63.6 (9.9), 31-83	60.3 (15.1), 23-79	3.3, 0.281
Body Mass Index (BMI)	25.5 (3.7), 19.3-35.5	26.2 (3.5), 20.8-32.3	-0.7, 0.521
Joint space width (mm)	1.7 (1.0), 0-4	1.2 (1.0), 0-3	0.5, 0.095
Observational movement quality analysis			
BARS-MQE total, 12-84 (best)	47.0 (6.7), 27-60	44.4 (4.6), 36-50	2.5, 0.164
Physical tests			
Chairs test, number in 30 sec;	13.9 (4.8), 0-24	14.8 (4.1), 8-23	-0.9, 0.506
Stairs test, sec;	58.7 (22.0), 32.2-143.3	68.6 (30.8), 31.1-154.3	-9.8, 0.136
6MWT, meters/6min;	496.8 (104.1), 210-804	475.1 (104.1), 342-758	21.6, 0.459
Questionnaires			
NRS pain walking, 0-10 (worst);	4.1 (1.8), 0-9	4.2 (2.6), 1-8	-0.2, 0.784
ASES pain, 5-25 (best);	17.6 (4.6), 6-25	14.9 (5.9), 5-25	2.7, 0.048*
ASES symptoms, 5-30 (best);	23.0 (4.4), 10-30	21.3 (5.3), 14-30	1.7, 0.188
EQ-5D-5L, index 0-1 (best);	0.7 (0.1), 0.3-1.0	0.6 (0.2), 0.1-0.8	0.1, 0.174
EQ-5D-5L, VAS 0-100 (best);	69.8 (15.0), 30-95	63.1 (22.5), 20-97	6.7, 0.142
HOOS P, 0-100 (best);	58.7 (16.0), 13-88	50.1 (16.8), 27.5-77.5	8.6, 0.061
HOOS S, 0-100 (best);	52.5 (19.8), 15-100	41.0 (21.1), 15-85	11.5, 0.043*
HOOS A, 0-100 (best);	68.0 (17.1), 29-100	63.4 (17.6), 29.4-98.5	4.5, 0.350
HOOS SP, 0-100 (best);	56.3 (19.3), 13-100	50.5 (23.9), 6.2-93.8	5.8, 0.304
HOOS QL, 0-100 (best);	48.1 (15.6), 13-81	36.3 (18.9), 0.0-68.	11.8, 0.010*
UCLA, 1-10 (best);	6.4 (2.2), 2-10	5.9 (1.7), 4-9	0.5, 0.414
HHS, 0-100 (best)	70.6 (11.9), 44-96	65.8 (10.2), 42-81	4.8, 0.154

*Statistically significant difference between baseline scores of participant included in analyses and participants lost to follow-up.

We found that the differences in baseline scores were marginal for our primary outcomes and most of the secondary outcomes. Poorer scores on ASES pain and HOOS, subscales S and QL in the group of drop-outs might indicate that we have lost data from those who were most affected by the OA disease. However, the differences on ASES pain and HOOS S were only marginally significant. With only one out of 16 measures showing truly significant poorer scores, the assumption that data was missing at random was supported. Acknowledging that participants lost to follow-up were asymmetrically distributed between the groups and therefore represented a risk of bias[194], we calculated the difference between baseline data for participants lost to follow-up in each of the study groups. We found only marginal differences, and considered therefore that the risk of bias due to asymmetrically missing data was acceptably low.

Strengths and limitations

In this PhD project, we introduced a physiotherapy approach and an evaluation tool that had previously not been investigated in hip OA. A strength of the thesis is that the therapy and evaluation were studied using both qualitative and quantitative research methods, so that the results complemented each other for a wider understanding[195]. Although movement quality was already well defined in BBAT theory, our participants' descriptions have broadened our understanding of the phenomenon by providing insight into how they described the meaning of their movement experiences and the movement awareness learning. We have also provided some insight into participants' perceived outcome from PE, to advice future education programs.

In Study I, we recruited participants that had been referred to an orthopaedic surgeon for assessment and consideration for hip replacement. The 7 included participants wished to postpone surgery and were highly motivated for the interventions offered. The study results may be limited to patients who have rather severe hip OA, but were not (yet) willing to undergo surgery, and might not be altogether representative for the participants included in the RCT.

There are important aspects of health that have not been investigated in the present PhD projects, such as fatigue, reduced self-esteem, body satisfaction, quality of sleep and coping. Such measures might be reflected in movement quality for people with hip OA and should be included in future studies.

Conclusion

This PhD project has shown that movement quality, evaluated by the BARS-MQE, was affected in the participants with hip OA, but with substantial variation. Many had scores like people who consider themselves healthy. Accordingly, not all individuals with hip OA can be expected to demonstrate dysfunctional movement quality. The movement quality scores were generally not well reflected in commonly used measures of function and health in hip OA, except for *walking* (BARS-MQE movement item 12). To observe and score this item in BARS-MQE may, accordingly, be of particular interest in this study group, as it might be an indicator of an individual's hip related function and health.

As a part of the BARS-MQE evaluation, individuals with hip OA provided insight into experiences of movement compensations, as well as movement strategies that they perceived as beneficial and healthy. In clinical practice, such verbalized movement experiences can be implemented directly into the following therapy promoting movement quality.

By participating in the BBAT and practicing the integration of healthy movement aspects into their movement habits, the intervention group improved their movement quality significantly. The impact of this improvement is unclear, as it was not reflected in improvements by the measures of pain, function and health used in our RCT. However, movement quality is probably an aspect of functioning that should be taken into consideration when it is found with low (poor) scores.

Participants described experiencing PE and BBAT as beneficial for function and self-management on short and long term. However, the present project did not find evidence that PE and BBAT in groups were more beneficial than PE alone. This may be due to the fact that 1) participants' level of function and health in many cases demonstrated a ceiling effect, 2) not all participants demonstrated dysfunctional movement quality, 3) the majority of comparison patients were found to receive other physiotherapy, and 4) poor compliance in some intervention participants. We found that a sufficient volume of BBAT training, 10 or more sessions, is needed to obtain a satisfactory outcome.

Future perspectives

We propose that future research on effects from physiotherapy in hip OA takes into account that symptoms and function may be vastly heterogeneous in this group of individuals. With more specific inclusion criteria, researchers might identify groups of people who share the same needs regarding their health and function, and apply physiotherapy modalities that target those specific needs.

Regarding movement quality in hip OA, we propose that the impact of movement quality in defined groups of individuals is investigated in future research, differentiating between those with functional and dysfunctional movement quality. Based on individual's own described outcome from BBAT, measures of general health aspects like fatigue, self-esteem, body satisfaction, quality of sleep and coping might be better related to movement quality in hip OA than measures of pain during walking and function in activities of daily life, and should be included in future investigations of BBAT. Researchers might also consider increasing the dose of BBAT with a higher frequency of sessions or a longer duration of the intervention period.

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RESEARCH ARTICLE

WILEY

Movement quality evaluation and its correlation with recommended functional measures in hip osteoarthritis

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Abstract

Objective: Hip osteoarthritis may cause compensational movement strategies that require extra physical and mental effort. Such aberrant functioning can be captured in movement quality evaluation. The objective of this study was to explore whether movement quality, evaluated as a multiperspective phenomenon, is reflected in commonly used and recommended functional measures in this group of patients.

Methods: A cross-sectional study design was used. Baseline included 80 female and 21 male participants with hip osteoarthritis. Movement quality was evaluated by the Body Awareness Rating Scale—Movement Quality and Experience (BARS-MQE), part one, including 12 movement items. Correlation analyses (Pearson and Spearman) were performed to explore associations between BARS-MQE (sum score and single item scores), and scores on measures of physical capacity (Chair test, Stairs test, 6 minutes walking test; 6MWT), self-reported activity level (UCLA), function (HOOS subscales), pain during walking (NRS), self-efficacy (ASES) and health (EQ-5D-5L). Based on previous evidence, we hypothesized moderate associations between BARS-MQE and these measures.

Results: BARS-MQE's sum score showed moderate associations with Stairs test, 6MWT and UCLA (r = –0.425 to 0.304) and weak associations (r = 0.29 to 0.12) with ASES Pain and Symptoms, HOOS ADL, Chair test, NRS, HOOS Pain and Sports, and EQ-5D-5L. No association was found between BARS-MQE and HOOS Symptoms and Quality of life. Movement quality in item 12, *walking*, demonstrated moderate or weak association with all included measures.

Conclusion: In this study of participants diagnosed with hip osteoarthritis, movement quality evaluated by BARS-MQE was moderately reflected in measures of physical capacity and activity, but weakly reflected in self-reported measures of health problems. With its particular dynamic procedure and inclusion of the whole moving person, movement quality evaluation by the BARS-MQE was shown to provide supplementary information on functioning, scarcely captured by the commonly used and recommended measures.

1 | INTRODUCTION

Optimal movement and functional capacity are core aims in physiotherapy in order to promote patients' ability to engage with their environment in daily life (APTA, 2018). A person's movement habits can be influenced by external factors like culture, work and social life, and internal factors like symptoms and pain from the musculoskeletal system (Hodges & Tucker, 2011; Zeni, Pozzi, Abujaber, & Miller, 2015). Compensational adaptations may have short-term benefits, but potential long-term consequences as they often include asymmetry and restricted freedom of movement and may lead to dysfunctional movement habits (Hodges & Tucker, 2011). Although physiotherapists consider movement quality an important feature to address in the rehabilitation process, there are great diversities in the way they understand and describe this phenomenon (van Dijk, Smorenburg, Visser, Nijhuis-van der Sanden, & Heerkens, 2017). In the present study of patients with hip osteoarthritis, movement quality is understood as a unifying phenomenon that encompasses both physical and mental perspectives (Dropsy, 1984) as described more extensively below.

Several measurement tools have been developed to quantify clinically observed movement quality in adults with musculoskeletal conditions. In the Standardized Mensendieck Physiotherapy Test (SMT), movement quality is described as patients' cognitive self-awareness expressed in global and local body functionality, and the test includes evaluation of standing and sitting posture, specific movements/tasks, gait and respiration (Haugstad et al., 2006). SMT was not considered eligible for the present study, as its convergent validity has been found to be poor in a study of patients with chronic pain conditions, including osteoarthritis (Keessen, Maaskant, & Visser, 2018). Another tool is the Functional Movement Screen (FMS), which is used to predict athletes' ability to return to sport (Cook, Burton, Hoogenboom, & Voight, 2014). In FMS, movement quality is described as degrees of biomechanically efficient movement patterns in seven extreme body positions like deep squat, hurdle step and push-ups. Due to hip-related movement restrictions and/or symptoms, we expected that few of the patients in our sample would be able to perform the rather challenging exercises included in the FMS.

A person-centered, multiperspective view on movement quality is implemented in the physiotherapy approach, Basic Body Awareness Therapy (BBAT), integrating biomechanical, physiological, psychological and personal aspects into movement (Skjaerven, 2019; Skjaerven, Kristoffersen, & Gard, 2008). Two evaluation tools, a Swedish and a Norwegian, are used within BBAT. The Swedish, Body Awareness Scale Movement Quality and Experience (BAS MQ-E) was developed from the original BAS (Roxendal, 1985). It includes 23 movement items representing everyday functions like walking, standing on one leg, stomping and stepping up onto a chair (Hedlund, Gyllensten, Waldegren, & Hansson, 2016). The score is based on three factors of observation, such as stability in function, centring/breathing and relating/awareness (Sunden, Ekdahl, Horstman, & Gyllensten, 2014) as well as a self-report questionnaire on body experiences, symptoms and coping strategies (Hedlund et al., 2016).

The Norwegian, Body Awareness Rating Scale–Movement Quality and Experience (BARS-MQE), which is used in the present study, was developed from the original BARS (Friis, Skatteboe, Hope, & Vaglum, 1989; Skatteboe, 2005; Skatteboe, Friis, Hope, & Vaglum, 1989). BARS-MQE includes two parts. In part one, the physiotherapist observes, evaluates and scores movement quality in 12 movement items extracted from the original BBAT program (Dropsy, 1984). The movements represent daily life functions, such as lying, sitting, standing and walking (Skjaerven, 2015). The evaluation of movement quality is focused on how balance, free breathing and awareness are integrated and expressed in the movements. Part two is a phenomenological inquiry, where the patient is invited to verbalize immediate movement experiences in each of the 12 movements. Part two is not included in the present study, but has been presented previously (Olsen, Strand, Magnussen, Sundal, & Skjaerven, 2019).

The BARS-MQE scoring criteria are rooted in research on the phenomenon of movement quality (Skjaerven, 2019), presenting a multi-perspective differentiation of movement elements and aspects visualized in the movement quality model developed for clinical use (Skjaerven et al., 2008; Skjaerven, Kristoffersen, & Gard, 2010). Unique for BARS-MQE is its health-directed process orientation. Using a specific strategy, pedagogy and vocabulary to promote functional movement (Skjaerven, Gard, Gomez-Conesa, & Catalan-Matamoros, 2019), the physiotherapist invites the patient to explore, adjust and potentially develop the movement quality through 5–10 repetitions of each movement item (Skjaerven, Gard, Sundal, & Strand, 2015). With this, the BARS-MQE evaluation includes the patients´ adaptability to a change towards more functional movement habits. When physiotherapy for patients with hip osteoarthritis is aimed to improve compensatory movement habits, it is of value to reveal the patient's ability to make contact with and utilize own possibilities for adjustment. Recognizing the wide range of aspects that contribute to a person's movement functionality, we chose BARS-MQE for the movement quality evaluation in the present study.

Hip osteoarthritis is a common musculoskeletal condition (GBD, 2017), where patients tend to develop compensational movement strategies with increased demand on other body regions, subsequently leading to additional pain and dysfunction (Rutherford, Moreside, & Wong, 2015; Tanaka et al., 2015; Zeni, et al., 2015). Patients' quality of life can also be negatively influenced by personal and social factors, such as lacking ability to interpret and deal with symptoms constructively, or experiences of lost identity in social settings (Smith et al., 2014). Thus, a bio-psycho-social approach is recommended for physiotherapy evaluation and treatment (Kolasinski et al., 2020). From such a multiperspective view on health, we aimed in the present study to investigate whether movement quality, evaluated by the BARS-MQE as a multiperspective phenomenon, is reflected in commonly used indicators of function and health in this group of patients, or if it should be evaluated as a unique characteristic of movement function. As the movements in BARS-MQE represent a broad spectre of daily-life movements, a secondary aim was to investigate whether single movement items stood out with a particularly strong association. Research question: Is observed movement quality evaluated by the BARS-MQE (sum score and its 12 movement items, separately) associated with commonly used and recommended measures of function and health in patients diagnosed with hip osteoarthritis?

2 | METHODS

2.1 | Design

A cross-sectional design was applied to investigate association between the measures.

2.2 | Patients

The study included participants with hip osteoarthritis from a randomized controlled clinical trial (RCT) investigating effects of Basic Body Awareness Group Therapy (BBAT) (Clinical Trials ID: NCT02884531). Inclusion criteria: Adults with primary hip osteoarthritis according to the American College of Rheumatology Clinical Criteria (Altman et al., 1991), living reasonably close to the intervention site. Exclusion criteria: Health problems that preclude movement training and participation in an educational program, drug abuse, not speaking Norwegian and pregnancy between 5 and 9 months. Based on power calculation, 100 patients were required for the RCT, which is also a sufficient sample for the present correlation study (de Vet, Terwee, Mokkink, & Knol, 2011).

2.3 | Data collection

All measures were collected in the same session for each participant and by the same therapist. First, movement quality was evaluated and thereafter, the three physical capacity tests were conducted. Finally, the participants filled in self-report questionnaires on pain during walking, level of physical activity, self-efficacy, perceived health and hip-related functional problems. Assessment was performed before randomization, hence the assessor and the patients were blinded to group allocation. Baseline data from all participants of the RCT (n = 101) were included.

2.4 | Asessment tools

2.4.1 | The Body Awareness Rating Scale – Movement Quality and Experience

The most functional movement quality observed during each of the 12 movement sequences is scored on an ordinal scale from 1 (dysfunctional movement quality) to 7 (very good functional movement quality) (Skjaerven et al., 2008, 2015). The sum score of the 12 movements ranges from 12 to 84. In a study of patients with long-lasting musculoskeletal disorders and mental health problems, reliability of the BARS-MQE was found to be high, with ICCs of inter-tester and test–retest reliability 0.99 and 0.96, respectively. BARS-MQE was found to discriminate between patients and healthy persons. It also correlated moderately with the general perceived self-efficacy scale (GPSES) and most subscales of the Short-Form Health Survey (SF-36) (Skjaerven et al., 2015).

2.5 | Assessment tools examined for association with BARS-MQE

2.5.1 | Physical capacity tests

Chair test: the number of repeated rising from and sitting down on a chair during 30 s is counted. High intra-rater and inter-rater reliability has been found in patients with hip/knee osteoarthritis, with ICC = 0.85 and 0.86, respectively (Dobson et al., 2017). *Stairs test*: the time, by seconds, used to walk up and down 18 steps × 3 is measured (Tveter, Dagfinrud, Moseng, & Holm, 2014). *6 minutes walking test (6MWT)*: the walking distance during six minutes is measured in meters. High inter-rater and intra-rater reliability has been found in patients with hip/knee osteoarthritis, with ICC = 0.94 and 0.93, respectively (Dobson et al., 2017).

2.5.2 | Self-report questionnaires

Pain intensity during walking within the last week was assessed by a 0–10 point *Numeric Rating Scale (NRS)*. High test–retest reliability has been reported in patients with knee osteoarthritis (ICC = 0.95) (Alghadir, Anwer, Iqbal, & Iqbal, 2018). The *University of California Los Angeles activity score (UCLA)* was used to assess the self-reported level of physical activity during the last month on a 10-point ordinal scale from totally sedentary (dependent on other persons) to regularly participating in high-intensity physical activities (running, tennis, skiing, heavy work, hiking, etc.) (Naal, Impellizzeri, & Leunig, 2009). Criterion validity was indicated as UCLA strongly correlates with steps/day as recorded by pedometer (Zahiri, Schmalzried, Szuszczewicz, & Amstutz, 1998). Excellent test–retest reliability has been reported (k_w = 0.80, 95% CI, 0.70–0.90), and UCLA was found able to discriminate between active and inactive patients with hip OA (Naal et al., 2009). The *Hip Osteoarthritis Outcome Score (HOOS)* is an instrument to assess the patients' opinions about their hip and associated problems, as perceived during the last week (Klassbo, Larsson, & Mannevik, 2003). It contains questions of five domains: pain (P), symptoms (S), Activities of Daily Life (A), sport and recreation (SP) and hip-related quality of life (QL) (Nilsdotter, Lohmander, Klassbo, & Roos, 2003). Each item is answered on a Likert scale (no, mild, moderate, severe and extreme) and scored from 0 to 4. The sum score of each domain is transformed to a normalized scale from 0 (extreme problems) to 100 (no problems). HOOS has shown high test–retest reliability (ICC for subscales ranging from 0.78 to 0.91) (Klassbo et al., 2003). Construct validity has been supported by high correlations with the Oxford Hip Score (r_s = 0.822) and the SF-36 (r_s = −0.664) (Arbab, van Ochten, Schnurr, Bouillon, & Konig, 2017). The *Arthritis Self-efficacy Scale (ASES)* is a questionnaire about self-efficacy regarding pain, symptoms and physical function for patients with arthritis (Lorig, Chastain, Ung, Shoor, & Holman, 1989). The subcategories, Pain and Symptoms, were included in the present study. The sub-category, Pain, consists of five questions, each to be answered on a Likert scale (1–5) from very unsure to very sure (sum-score from 5 (worst) to 25 (best). The sub-category, Symptoms, consists of six questions, with a sum-score from 6 (worst) to 30 (best). High test–retest reliability has been reported, *r* = 0.87 for pain and 0.90 for symptoms (Lorig et al., 1989), as well as evidence for validity (Brekke, Hjortdahl, & Kvien, 2003). Finally, the *EuroQol (EQ-5D-5L)* is a generic health index comprising a five-part questionnaire and a visual analogue self-rating scale (EuroQol, 1990). The five dimensions concern mobility, self-care, usual activities, pain/discomfort and anxiety/depression, each scored on a five-point scale from no problem (score 1) to extreme problems (score 5). An EQ index is calculated, ranging from 0.0 (worst health) to 1.0 (best health). The EQ VAS records the respondents' self-rated health on a vertical, visual analogue 0–100 scale (Best to worst imaginable health state). Test–retest reliability has been reported in patients referred for hip or knee replacement, ICC for the five items ranging from 0.61 to 0.77 (Conner-Spady et al., 2015).

2.6 | Analysis

Descriptive statistics was used to present demographic characteristics and test scores. Pearson and Spearman correlation analyses were used to examine the pairwise association between the BARS-MQE (total score and item scores) and scores of the included measures of function and health. Linearity was indicated, and Pearson (*r*) correlation coefficients were, therefore, presented. The interpretation of correlations followed guidelines suggested by Cohen (1988); low: *r* = 0.10–0.29, moderate: *r* = 0.30–0.49 and high: *r* = 0.50–1.0. Percentile bootstrap 95% confidence intervals were calculated. Statistical packages used: IBM SPSS Statistics 24 (Pallant, 2016) and R 3.5.1 (R Core Team, 2019).

For further guidance in the interpretation of the study results, we used information from a previous study of 50 patients with long-lasting musculoskeletal and mental health problems. In that study,

TABLE 1 Demographic characteristics and test scores at baseline, (*n* = 101)

Variables	*n*	Mean (SD)	Min–max
Demographic variables			
Sex; female, n (%)	101	80.0 (79.2)	
Age, years	101	63.1 (10.8)	23–83
Body mass index (BMI)	101	25.6 (3.6)	19.3–35.5
Observational movement quality evaluation			
BARS-MQE total, scale 12–84 (best)	101	46.6 (6.5)	27–60
Physical capacity tests			
Chair test, number of raise in 30 sec	101	14.1 (4.7)	0–24
Stairs test, sec;	101	60.2 (23.6)	31–154
6MWT (meters in 6 min)	101	493.6 (103.9)	210–804
Questionnaires			
NRS pain during walking, scale 0–10	100	4.1 (2.0)	0–9
UCLA, scale 1–10 (best)	101	6.3 (2.1)	2–10
HOOS P, scale 0–100 (best)	101	57.4 (16.4)	12.5–87.5
HOOS S, scale 0–100 (best)	101	50.8 (20.3)	15–100
HOOS A, scale 0–100 (best)	101	67.3 (17.2)	29.4–100
HOOS SP, scale 0–100 (best)	101	55.5 (20.0)	6.2–100
HOOS QL, scale 0–100 (best)	101	46.3 (16.6)	0.0–81.2
ASES pain, scale 5–25 (best)	101	17.5 (4.9)	5–25
ASES symptoms, scale 5–30 (best)	101	22.8 (4.6)	10–30
EQ-5D-5 L, index 0–1 (best)	101	0.68 (0.13)	0.05–1.00
EQ-5D-5 L, scale (VAS) 0–100 (best)	101	68.8 (16.4)	20–97

Abbreviations: 6MWT, six minute walk test; A, activities of daily life; ASES, Arthritis Self-efficacy Scale; BARS-MQE, Body Awareness Rating Scale–Movement Quality and Experience; EQ-5D-5L, EuroQol with five questions; HOOS, Hip Osteoarthritis Outcome Scale with subscales; NRS, Numeric Rating Scale; P, pain; QL, quality of life; S, symptoms; SP, sports/recreation; UCLA, University of California Los Angeles Activity Score.

TABLE 2 Scores on single movement items in the BARS-MQE (n = 101)

Items		Mean (SD), min–max
1 lying	Contact with the ground	4.3 (0.8), 1.5–5.5
2 lying	Closing legs together	3.9 (0.8), 1.5–5.0
3 lying	Symmetrical stretching	3.7 (1.0), 1.0–5.5
4 lying	Asymmetrical stretching	3.6 (1.0), 1.0–5.0
5 sitting	Sitting balance	4.6 (0.8), 2.5–6.0
6 standing	Up-down along the vertical axis	4.0 (0.7), 2.0–5.0
7 standing	Sideways movement	3.5 (0.8), 1.5–5.5
8 standing	Turning around the vertical axis	4.0 (0.8), 2.5–5.5
9 standing	Arm movement	3.8 (0.9), 2.0–6.0
10 standing	Flexing/extending the trunk	3.5 (0.9), 1.5–5.5
11 standing	Relational movement	3.8 (0.8), 1.5–5.5
12 walking	Walking	3.8 (0.7), 2.0–5.0

Abbreviation: BARS-MQE, Body Awareness Rating Scale–Movement Quality and Experience.

movement quality by BARS-MQE was found to be moderately associated with self-reported quality of life assessed by the Short-Form Health Survey (SF-36), subscales for physical and mental function, and self-efficacy assessed by the General Perceived Self-efficacy Scale (GPSES) (Skjaerven et al., 2015). We, therefore, generally hypothesized moderate associations between movement quality by the BARS-MQE and measures of physical capacity, self-efficacy and quality of life in our study.

3 | RESULTS

Descriptive data on patient characteristics and test scores from the participants, 21 men and 80 women aged 23–83 years, are presented in Table 1. The sum score of BARS-MQE was normally distributed and ranged between 27 (mostly dysfunctional movement quality) and 60 (good functional movement quality). The highest mean score on single movement items was found in item 5, *sitting balance*, and the lowest mean scores were found in standing item 7, *sideways movement*, and item 10, *flexing/extending the trunk*, see Table 2.

3.1 | Associations between the BARS-MQE sum score and physical tests and self-report questionnaires

Movement quality, evaluated by the BARS-MQE sum score, was found to be moderately associated with the Stairs test (r = .42), 6MWT (r = .37) and UCLA (r = .30). Weak association was found between the BARS-MQE sum score and the Chairs test, NRS walking, ASES pain, ASES symptoms, EQ index, EQ VAS, HOOS P, HOOS A and HOOS SP, and no association was found with HOOS S and HOOS QL, see Figure 1.

3.2 | Association between single items of BARS-MQE and physical tests and self-report questionnaires

Movement quality in item 12, *walking*, was moderately associated with several assessment tools like the Stairs test, 6MWT, UCLA, ASES pain, NRS walking and Chairs test (r ranging from .43 to .30), while it showed weak association with the remaining measures, see Figure 1. Movement quality in item 7, *sideways movement*, item 9, *arm movement*, and item 11, *relational movement* (all in standing), was moderately associated with Stairs test and 6MWT, and item 11 was additionally found to be moderately associated with the UCLA. Item 1, *contact with the ground* (lying), was moderately associated with the 6MWT. For the remaining measures, movement quality of single BARS-MQE items showed weak or no association.

4 | DISCUSSION

In this study, we investigated the association between movement quality, analysed and evaluated by BARS-MQE, and recommended physical capacity tests and self-report questionnaires in patients with hip osteoarthritis. Movement quality was found with moderate or weak association with most of the measures of function and health, and generally strongest association with measures of physical capacity and activity (*Stairs test*, *6MWT* and *UCLA)*. Movement quality in BARS-MQE item 12, *walking*, was found to be of particular interest, as it showed moderate or weak association with all the included measures of function and health. The findings support our hypothesis of moderate association between movement quality evaluation and physical capacity tests, but the associations with measures of quality of life and self-efficacy were weaker than expected. Movement quality is, apparently, to a limited degree reflected in commonly used functional measures in patients with hip osteoarthritis. In the following, we will discuss our findings in relation to baseline scores and the constructs assessed by the included measures.

Mean scores on the 6MWT and Chairs test were similar to those reported in a previous study of patients with hip osteoarthritis (Bieler, Magnusson, Kjaer, & Beyer, 2014), indicating that our sample is likely to be representative for the patient population regarding physical capacity. Compared with normative BARS-MQE scores of 55 points, as reported in a previous study (Skjaerven et al., 2015), patients included in our sample scored lower (mean 46.6 points) on movement quality. This was expected since compensational movement patterns are common in hip osteoarthritis (Eitzen et al., 2015; Lin et al., 2015). The range of movement quality scores was from 27 to 60. According to the BARS-MQE manual, a score of 27 points is characterized by an unstable vertical axis, lack of rhythm and elasticity, weak intention and direction in the movement, inappropriate amount of energy used, and lack of unity

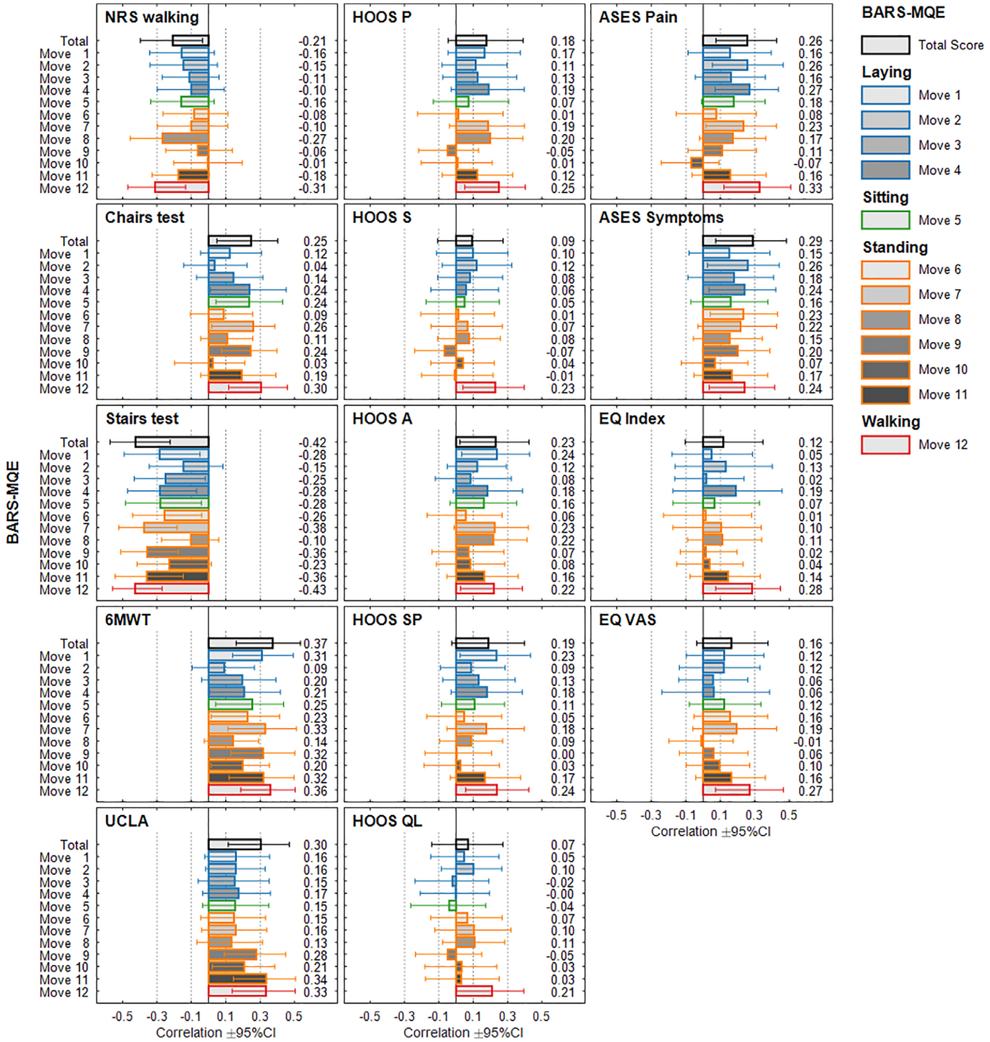

FIGURE 1 Strenght of correlation (Pearson's *r*) between BARS-MQE sum score (total) or scores of separate BARS-MQE items (Move 1 to 12) and test scores of Numeric Rating Scale (NRS) for pain during walking, Chairs test, Stairs test, 6-minutes' walk test (6MWT), University of California Los Angeles Activity Score (UCLA), Hip Osteoarthritis Outcome Score (HOOS) subscales pain (P), symptoms (S), Activities of daily life (ADL), sports/recreational (SP), quality of life (QoL), Arthritis Self-efficacy Scale (ASES) subscales pain and symptoms, EuroQol (EQ5D) Index and VAS scale in 101 patients with hip osteoarthritis. Negative/positive directions and 95% confidence intervals of correlations (bootstrap) are illustrated using box-and-whisker plots

between center-periphery and upper/lower body. A movement quality score of 60 points, on the other hand, reflects a well balanced, stable and free vertical axis, functional form, flow, elasticity and rhytm, intentional clarity, appropriate use of energy, unity and integration in the whole moving person. This shows that movement quality can vary substantially between patients with hip OA.

4.1 | BARS-MQE versus physical capacity tests

BARS-MQE sum score was found with moderate association with the Stairs test and 6MWT, which was in line with our hypothesis, but only weak association with the Chair test. Moderate association was expected since basic elements of movement quality, like dynamic stability and movement co-ordination, are regarded supportive for the effectiveness of physical tasks (Shumway-Cook & Woollacott, 2017). Sunden et al. (2014), showed even higher association between the 6MWT and movement quality assessed by the BAS MQ-E (*r* = −.557) in their study of patients with hip osteoarthritis. Weak association with the Chair test may be due to the fact that the particular function of rising up from a sitting position is not implemented in the BARS-MQE. Although patients with hip osteoarthritis tend to compensate by unloading the involved limb when performing the sit-to-stand test (Eitzen, Fernandes, Nordsletten, Snyder-Mackler, & Risberg, 2014), such compensations may not be captured by the BARS-MQE.

The associations between movement quality, evaluated by the BARS-MQE, and physical capacity tests were generally not high, which may be due to differences in the instruments' construct, communication, guidance and scoring procedure. First, while the BARS-MQE score is based on the physiotherapists' movement analysis and clinical reasoning (Skatteboe, 2005; Skjaerven et al., 2008, 2015), the scores of physical capacity are based on simple recordings using a stop-watch. Second, the BARS-MQE provides a specific movement vocabulary (Skjaerven et al., 2019) and interaction between physiotherapist and patient, guiding the patient to develop and adjust to emerging movement quality. In the physical capacity tests, on the other hand, the patients are instructed to move as fast as they can within safe limits (Tveter et al., 2014) and are likely to be less aware of subtle movement nuances when trying to achieve a best possible time score. Indeed, from observing our patients performing the physical tests, we had the impression that a higher speed often enhanced their compensational movement habits, for example, with increased limping or shoulder elevation. Therefore, one might say that tests of physical capacity expose patients movement compensations during physically demanding tasks, while the BARS-MQE provides a platform for patients to become aware of and activate functional movement potentials in safe, small and slow movements. With regard to fundamental differences in focus, communication, guidance and procedure, strong associations between scores on BARS-MQE and physical capacity test might not be expected.

Regarding single BARS-MQE items, four items that require the combination of hip joint movement and weight-bearing (items 7, 9, 11 and 12) were found moderately associated with the Stairs test and the 6MWT, and item 12 was moderately associated also with the Chair test. As weight-bearing and -shifting can be challenging for patients with hip osteoarthritis (Leigh, Osis, & Ferber, 2016), at least a moderate association was expected. There are strong similarities between the activity of walking in item 12 and walking over time in the 6MWT. The scoring of movement quality in item 12 is, however, not only based on the way walking is performed, but also includes an evaluation of the patient's ability to relate to the physical room (walking in a circle). This aspect of adjusting to surroundings may be of particular importance while walking up/down stairs, and may explain why we found the strongest association between item 12 and the Stairs test (*r* = −.43).

Interestingly, we found that movement quality scores in lying movements were generally not higher (better) than those in weightbearing activities, standing and walking (Table 2). There is little previous research describing the consequences that compensational movement habits may have on the upper body in patients with hip osteoarthritis. However, increased pelvic tilt and sideways leaning of the trunk, during walking, are commonly observed in this condition (Meyer et al., 2015), and may have consequences for breathing and for muscular functions in the upper body. As evaluated by the BARS-MQE, blocked breathing and muscular stiffness in the trunk can be observed in movement aspects like elasticity, rhythm, energy and unity also in lying movements. By including the whole moving person from head to feet, movement quality evaluation by the BARS-MQE may thereby complement measures of physical capacity for a broader evaluation.

4.2 | BARS-MQE versus self-report questionnaires on function and health

The association between movement quality and level of physical activity (UCLA) was found to be moderate. This could be expected, based on the assumption that patients who exercise regularly also activate more of their movement potential, hence more functional movement quality, than sedentary persons. As for measures of self-reported function and health, their association with the movement quality scores were mainly weak. This was unexpected, based on previously reported moderate associations between BARS-MQE scores and measures of quality of life (SF-36) and self-efficacy (GPSES) in patients with non-specific musculoskeletal and mental problems (Skjaerven et al., 2015). Explanations for these diverging findings may be differences in the patient populations, and that SF-36 and GPSES, both, are generic questionnaires, unlike the hip-focused questionnaires used in the present study. While the BARS-MQE movement quality evaluation was health-oriented, most of the questionnaires were focused on pain or functional problems related to the hip. Similar to our findings, Sunden et al. (2014) found that movement quality evaluated by the BAS MQ-E was strongest when associated with questionnaires that concerned physical activity, such as HOOS SP and SF-36 (physical component) in patients with hip osteoarthritis. Similarly, in the present study, week or no association was found between movement quality and most HOOS subscales. When including the whole moving person in movement quality evaluation, strong associations with questionnaires on hip-specific problems might not be expected.

Another reflection is that the BARS-MQE score is built on the immediate here-and-now setting, (Skatteboe et al., 1989), which has a different focus than pro- and retrospect reflections on health and function as they are requested in self-report questionnaires. Results from previous studies show that patients' responses to questionnaires may be re-calibrated by recent health-related events like symptom fluctuations, even if their physical function not necessarily changed as a result of those events (Daltroy, Larson, Eaton, Phillips, & Liang, 1999; Terwee et al., 2006). Recent symptom fluctuations (Cross et al., 2017) may have influenced participants' responses to questionnaires in the present study, but not necessarily influenced their movement quality.

4.3 | Methodological considerations

The validity of the study findings is strengthened by a rather large sample size (n = 101). During data collection, the BARS-MQE movement quality evaluation was conducted prior to physical tests and self-report questionnaires and was, therefore, not influenced by any of the other measurements. Patients' responses on self-reports may, however, have been influenced by their experiences from the immediate foregoing physical tests, as described by Daltroy et al. (1999) and Magnussen, Strand, and Lygren (2004).

There are some limitations to this study. Although, generally, more women than men have hip osteoarthritis (Prieto-Alhambra et al., 2014), the proportion of females was larger in our sample than the general population and may have influenced our results. Furthermore, in lack of a gold-standard for movement quality evaluation and sufficient literature to formulate evidence-based a priori hypotheses, the present study was of an exploratory nature. More research is needed to provide evidence for the relevance of movement quality evaluation in patients with hip osteoarthritis.

5 | CONCLUSION AND IMPLICATIONS FOR PHYSIOTHERAPY PRACTICE

In the BARS-MQE movement quality evaluation, the whole moving person is included. In this study, the participants diagnosed with hip osteoarthritis were found to have less functional movement quality than non-symptomatic persons examined in a previous study, showing that the condition has an impact on movement quality, although with substantial variability. Movement quality was moderately reflected in measures of physical capacity and activity, but weakly reflected in measures of self-reported health problems. With its particular procedure of revealing movement resources as well as restrictions, the BARS-MQE was found to demonstrate supplementary characteristics of functioning and health than captured by recommended and commonly used measures in hip osteoarthritis.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS

The Norwegian Regional Committees for Medical and Health Research Ethics approved the study (number 2013/2252/REK). The participants signed an informed consent form.

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IV

APPENDIX 1

Approval from the Norwegian Committees for Medical and Health Research Ethics for the pilot study.

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK nord	Veronica Sørensen	77620758	17.02.2014	2013/2252/REK nord
			Deres dato:	Deres referanse:
			29.01.2014	

Vår referanse må oppgis ved alle henvendelser

Liv Inger Strand
Institutt for global helse og samfunnsmedisin, Kalfarveien 31

2013/2252 Fysioterapi ved hoftearthrose, en pilot RCT

Forskningsansvarlig institusjon: Haukeland Universitetssjukehus
Prosjektleder: Liv Inger Strand

Prosjektleders prosjektomtale
Forekomst av hofteartrose øker i vestlige land, og et økende antall personer blir operert med total hofteprotese. Selv om kliniske retningslinjer anbefaler at konservativ behandling forsøkes først, blir det vanligvis ikke prøvd ut på en adekvat måte før operasjon . Dette skyldes sannsynligvis manglende evidens for kort- og langtidseffekt av slik behandling. Gjennom informasjon og motivasjon kan pasientene gjøres i stand til å forbedre sin egen helsetilstand, også ved hofteartrose. Flere studier har vist lovende resultater av hofteskole med fokus på pasientenes egne ressurser. Supplerende effekt av veiledet trening over tid hvor formålet er å bedre motorisk kontroll og kroppsopplevelse i vektbærende aktiviteter, har imidlertid ikke blitt tilstrekkelig utprøvd hos pasienter med hofteartrose. Formålet med studien er å sammenligne effekt av bare hofteskole og av hofteskole kombinert med gruppetrening over en periode på 12 uker, for pasienter henvist til utredning for hofteartrose.

Vurdering
Vi viser til tilbakemelding av 29.1.2014, samt korrigerende mail av 12.2.2014. REK anser at tilbakemeldingen er i tråd med de merknader som ble gitt i utsettelsesvedtak av 22.1.2014.
Videre har REK registrert at endringene også er inntatt samtykkeskrivet.

Etter fullmakt er det fattet slikt

Vedtak
Med hjemmel i helseforskningsloven § 10 og forskningsetikkloven § 4 godkjennes prosjektet.

Sluttmelding og søknad om prosjektendring
Prosjektleder skal sende sluttmelding til REK nord på eget skjema senest 04.08.2015, jf. hfl. § 12. Prosjektleder skal sende søknad om prosjektendring til REK nord dersom det skal gjøres vesentlige endringer i forhold til de opplysninger som er gitt i søknaden, jf. hfl. § 11.

Klageadgang
Du kan klage på komiteens vedtak, jf. forvaltningslovens § 28 flg. Klagen sendes til REK nord. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK nord, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Med vennlig hilsen

May Britt Rosssvoll
sekretariatsleder

Veronica Sørensen
rådgiver

Kopi til: postmottak@helse-bergen.no

APPENDIX 2

Approval from the Norwegian Committees for Medical and Health Research Ethics for the RCT.

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK nord			24.08.2015	2015/1392/REK nord
			Deres dato:	Deres referanse:
			16.06.2015	

Vår referanse må oppgis ved alle henvendelser

Liv Inger Strand
Institutt for global helse og samfunnsmedisin

2015/1392 Fysioterapi ved hofteartrose

Forskningsansvarlig: Universitetet i Bergen
Prosjektleder: Liv Inger Strand

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK nord) i møtet 13.08.2015. Vurderingen er gjort med hjemmel i helseforskningsloven § 10, jf. forskningsetikkloven § 4.

Prosjektleders prosjektomtale
Studien skal gi ny kunnskap om et gruppetilbud, Basic Body Awareness Therapy, BBAT, kan reduserte muskel-skjelettplager ved hofteartrose, mer enn det som oppnås gjennom hofteskole. BBAT innebærer trening av bevegelseskvalitet for hele kroppen Det vil bli benyttet et RCT design og 100 pasienter med hofteartrose rekrutteres blant pasienter som henvises fra primærhelsetjenesten til en artroskole på Lærings- og mestringssenteret i Helse Bergen. Artroskolen etableres høsten 2015 for personer med hofte og kneartrose i Hordaland. Betydningen av å kun delta i hofteskolen (sammenligningsgruppe) vil også utforskes I forbindelse med PhD studien vil vi spesielt undersøk pasientenes kroppslige erfaringer med BBAT gjennom intervju , og undersøke om et måleinstrument som er utviklet for å måle bevegelseskvalitet har evne til å fange opp endring over tid. Det vil da bli benyttet hypotesetesting i samsvar med internasjonale anbefalinger for undersøkelse av måleinstrumentets "responsivitet".

Vurdering

Rekruttering
Det er opplyst at deltakere skal rekrutteres fra henviste pasienter til Ortopedisk avdeling på Haukeland Universitetssjukehus fra kommunehelsetjenesten/almennleger i Hordaland, for deltakelse i hofteskole på Lærings- og mestringssenteret. Det beskrives i søknaden at potensielle deltakere vil bli kontaktet pr telefon av Aarid Lilan Olsen (som jobber som fysioterapeut ved Haukeland) og informert om studien. Hvis de synes å være innenfor inklusjonskriteriene, vil de bli forespurt om de kan være interessert i å delta i studien. I så fall får de tilsendt informasjon, og bedt om å vurdere nøye om de er interessert og har anledning til å delta i studien. De blir så etter noen dager på nytt kontaktet av Liland Olsen pr. telefon og spurt om de vil delta eller ei.

Komiteen minner om at dersom forskningsdeltakeren kan anses å være i et avhengighetsforhold til den som ber om samtykke slik at forskningsdeltakeren vil kunne føle seg presset til å gi samtykke, så skal det informerte samtykket innhentes av en annen som forskningsdeltakeren ikke har slikt forhold til jf helseforskningsloven § 13. Svar på forespørsel om deltakelse bør ikke innhentes i en konsultasjons-/behandlingssituasjon og det må ikke avkreves et aktivt nei-svar hvis man ikke vil delta. Det må gis betenkningstid slik at de forespurte kan rådføre seg med andre. Et eventuelt samtykke til deltakelse må kunne leveres/sendes inn på eget initiativ.

Komitéen aksepterer ikke at potensielle deltakere kontaktes pr telefon, utover at purring kan skje via SMS.

Forespørsel/informasjonsskriv/samtykkeerklæring
Følgende må fjernes fra informasjonsskrivet: *«Du er kontaktet pr. telefon og orientert om studien av daglig prosjektleder for studien, og har fått tilsendt skriftlig informasjon. Du vil igjen bli kontaktet pr. telefon i løpet de nærmeste dagene.»*

Vedtak
Prosjektleders tilbakemelding imøteses. Den videre behandling av prosjektsøknaden vil bli foretatt av komiteens leder/nestleder og sekretær, med mindre det reises spørsmål som må behandles av samlet komité.

Vennligst benytt skjema for tilbakemelding som sendes inn via saksportalen til REK http://helseforskning.etikkom.no. Tilbakemeldingen må være oss i hende innen seks måneder.

Med vennlig hilsen

May Britt Rossvoll
sekretariatsleder

Kopi til: *Rolv.Lie@uib.no*

APPENDIX 3

Informed consent form.

Fysioterapi ved hofteartrose

Forespørsel om deltakelse i forskningsprosjekt

Fysioterapi ved hofteartrose; en sammenligning av endring på kort og lang sikt av hofteartrosekurs alene eller en kombinasjon av hofteartrosekurs og bevegelsesgruppe.

"Fysioterapi ved hofteartrose, - en randomisert kontrollert studie"

Bakgrunn og hensikt
Dette er et spørsmål til deg om å delta i en forskningsstudie for å undersøke effekt av fysioterapi ved hofteartrose. I internasjonale kliniske retningslinjer anbefales det at rådgiving og trening forsøkes for å motvirke forverring av tilstanden. Gjennom rådgiving i et hofteartrosekurs vil du få informasjon om hofteartrose og hva du kan gjøre selv for å påvirke tilstanden positivt. Ved deltakelse i bevegelsesgruppe hos fysioterapeut vil du øve på bevegelser som kan utføres i dagliglivet, i stående, sittende og liggende stillinger. Formålet med denne studien er å undersøke om bevegelsesterapi, som har som hensikt å fremme mer funksjonelle og harmoniske bevegelser, i kombinasjon med hofteartrosekurs, gir et bedre behandlingsresultat enn deltakelse i hofteartrosekurs alene, og i så fall på hvilken måte.

Du forespørres om å delta i studien i forbindelse med at du skal delta i et hofteartrosekurs på Lærings og mestringssenteret i regi av Ortopedisk avdeling, Haukeland Universitetssjukehus. Studien blir gjennomført i et samarbeid mellom forskere på Universitetet i Bergen, Haukeland Universitetssjukehus og Høgskolen i Bergen. Universitetet i Bergen er ansvarlig for studien.

Hva innebærer studien?
Hofteartrosekurset er et tilbud for personer med hofteartrose i Hordaland. I forbindelse med kurset, planlegger vi en vitenskapelig studie hvor vi ønsker å kartlegge hvordan tilbudet virker, dvs. hvordan det går med deltakerne over tid mht. hofteplagene. Studien vil for alle innebære utfylling av noen spørreskjemaer og undersøkelse av funksjonsevnen. Noen kan også bli spurt om å fortelle om sine erfaringer i et intervju som kan bli tatt opp på lydbånd. Hvis du takker ja til å delta i studien, vil undersøkelsene bli gjennomført før deltakelse på hofteartrosekurset, etter 3 mndr og etter et år. Etter 5 år vil vi undersøke langtidseffekten ved å undersøke i Nasjonalt hofteregister om du er blitt operert eller ei. Anonymiserte data fra studien vil senere kunne inngå i en nasjonal database (register) for pasienter med hofte og kneartrose som behandles med fysioterapitiltak i første/andrelinjetjenesten.

Etter at hofteartrosekurset er gjennomført, vil de som har takket ja til å delta i studien, fordeles tilfeldig i to grupper, en gruppe som kun deltar på hofteartrosekurset og en som deltar både på kurset og i bevegelsesgruppe (Basic Body Awareness Therapy, BBAT). BBAT innebærer å øve på bevegelser i gruppe en gang pr uke over 10-12 uker, 1½ - 2 timer hver gang, og dessuten å trene på egenhånd hjemme etter avtale. Det må derfor være praktisk mulig for deg å komme til lokalene (som ligger like ved Haukeland Universitetssjukehus) en gang i uken over en tidsperiode på cirka 3 måneder. Gruppene finner sted mandager fra 15.15 til 16.45.

Hvis du vil delta i studien, etter å ha lest og vurdert dette informasjonsskrivet, kan du informere kontaktperson Hilde Pettersen på Ortopedisk avdeling om dette pr telefon **55 97 56 79** eller svare på SMS **94 13 61 28** og returnere samtykkeskjema pr post i vedlagte svarkonvolutt. Du blir i så fall innkalt til undersøkelse og testing hos fysioterapeut, om mulig på samme dag eller dagen før du deltar på hoftekurset.
Studien vil ikke innebære begrensninger for deg med hensyn til operasjon eller annen behandling som kan være aktuell for deg.

Det er frivillig å delta i studien og de som ikke samtykker, kan delta på hofteartrosekurset på lik linje med de som blir med i studien.

Mulige fordeler og ulemper. Trening, fysisk aktivitet og et godt kosthold har over tid vist seg å kunne redusere smerte og funksjonsplager hos mange med artrose, og dermed utsette behov for operasjon, og kan dessuten ha betydning for resultatet etter proteseoperasjon. Fysisk aktivitet og trening kan føre til økte smerter, men dette er vanligvis forbigående. Bevegelsene som inngår i BBAT er imidlertid lite smerteprovoserende ettersom de retter seg mot hele kroppen og det arbeides med å finne fram til harmoniske bevegelser og kvalitet i utførelsen. Deltakerne i studien vil gjennom hofteartrosekurset få gode råd om hva de kan gjøre på egenhånd. Å delta i BBAT innebærer å delta i et veiledet, tilpasset gruppeopplegg. Deltakelse i bevegelsesgruppen er gratis. Utgifter til offentlig transport ved undersøkelse i studien vil bli dekket med kr 100 hver gang.

Hva skjer med informasjonen om deg?
Undersøkelsene av deg og informasjonen som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste, men denne listen oppbevares atskilt fra dataene, og det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg. Denne navnelisten vil bli makulert etter at studien er avsluttet.
Det vil ikke være mulig å identifisere deg i resultatene fra studien når disse publiseres.

Frivillig deltakelse Det er frivillig å delta i studien. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke til å delta i studien. Dette vil ikke få konsekvenser for din videre behandling.

Dersom du vil delta, kan du kontakte Hilde Pettersen, kontaktperson på Ortopedisk avdeling, på telefon **55 97 56 79** eller sende SMS på **94 13 61 28**. Samtykkeerklæringen på siste side må undertegnes og samtykkeskjema returneres pr post i vedlagte svarkonvolutt.
Om du sier ja til å delta nå, kan du senere trekke tilbake ditt samtykke uten at det påvirker din øvrige behandling. Dersom du senere ønsker å trekke deg eller har spørsmål til studien, kan du kontakte Aarid Liland Olsen som er daglig prosjektkoordinator, tlf 94136128, eller Liv

Inger Strand som er prosjektleder, tlf 55586123, eller mobil 92462447, e-post: liv.strand@uib.no.

Fysioterapi ved hofteartrose

Ytterligere informasjon om studien finnes i kapittel *A – utdypende forklaring av hva studien innebærer.*

Samtykkeerklæring følger etter kapittel B

Kapittel A- utdypende forklaring av hva studien innebærer

Bakgrunnsinformasjon om studien

Forekomst av hofteartrose øker i vestlige land, og et økende antall personer blir operert med total hofteprotese. Selv om kliniske retningslinjer anbefaler at konservativ behandling forsøkes først, blir dette ofte ikke prøvd ut i tilstrekkelig grad før operasjon. Flere studier har vist lovende resultater av et hofteartrosekurs med fokus på pasientenes egne ressurser. Supplerende effekt av veiledet trening over tid hvor formålet er å bedre bevegelseskvalitet, harmonisk bruk og god opplevelse av kroppen i daglige, vektbærende bevegelser, har nylig vært prøvd ut i en mindre studie og vist lovende effekt hos pasienter med hofteartrose, også på lengre sikt. Formålet med studien er å sammenligne effekt av bare hofteartrosekurs, og hofteartrosekurs kombinert med bevegelsesgruppe over en periode på 10-12 uker (en gang pr uke).

Kriterier for deltakelse

Dere som forespørres om å delta i studien er henvist fra primærhelsetjenesten og registrert på Ortopedisk avdeling for deltakelse på hofteartrosekurset på Lærings- og mestringssenteret. De som har bekreftet hofteartrose både gjennom røntgenfunn og kliniske symptomer, forespørres om å delta i studien. Det er likevel en forutsetning at din generelle helsetilstand er god nok til at du kan delta, at du forstår norsk og ikke er gravid (5-9 mnd). De som velger ikke å delta i studien, vil delta i hofteartrosekurs på lik linje med de som vil delta i studien.

Undersøkelser og annet den inkluderte må gjennom

Deltakerne i studien svarer på en del spørsmål om bakgrunn (som alder, kjønn, vekt, høyde, varighet av hoftesmertene og andre relevante spørsmål) og fyller ut spørreskjema om smerte, funksjon og livskvalitet, og blir undersøkt med enkle kliniske tester for å undersøke funksjon. Noen kan bli spurt om å delta i intervju.

Tidsskjema – hva skjer og når skjer det?

Du har fått tilsendt informasjon om hva studien innebærer. Hvis du ut fra denne informasjonen kan tenke deg å delta, må du informere kontaktperson Hilde Pettersen på Ortopedisk avdeling om dette på telefon **55 97 56 79** eller via SMS på **94 13 61 28.** Undertegnet samtykke-erklæring returneres så i vedlagte svar-konvolutt. Du vil deretter bli innkalt til undersøkelse hos fysioterapeut. Undersøkelsen vil bli utført på Lærings- og mestringssenteret eller Haukeland Universitetssjukehus kort tid før hofteartrosekurset. Etter kurset får du trekke en konvolutt som fordeler deg tilfeldig i én av de to følgende gruppene: 1) de som deltar kun i hofteartrosekurs, men også i oppfølgingsundersøkelse etter tre måneder og ett år, og 2) de som deltar både i hofteartrosekurset og bevegelsesgruppe og oppfølgingsundersøkelsene. De som skal delta i bevegelsesgruppen får informasjon om tid og sted for denne.

Fordeler og ulemper med å delta i studien
Fordeler med å delta i studien er at den enkelte kan bidra til mer kunnskap og et bedre behandlingstilbud for pasienter med hofteartrose. Både hofteartrosekurset alene og i kombinasjon med bevegelsesgruppe, kan føre til redusert stivhet og smerte. Ulemper kan være forbigående økte smerter.

Studiedeltakerens ansvar
Det forventes at studiedeltakeren er en motivert samarbeidspartner ved å delta aktivt i behandlingen og møte opp til undersøkelsene.

Dekking av utgifter for deltakere
Deltakelse i hofteartrosekurset betales av deltakerne selv mens bevegelsesgruppene, som del av studien, er gratis. Reiseutgifter til undersøkelsene dekkes med kr 100.

Kapittel B - Personvern, biobank, økonomi og forsikring
Personvern
Opplysninger som registreres om deg er bakgrunnsinformasjon om f.eks. alder, kjønn, høyde og vekt, medikamentbruk, røntgenfunn og informasjon om smerte, funksjon og livskvalitet ved hjelp av spørreskjema, og fysisk funksjon undersøkt med tester av bevegelighet, asymmetri, og gangfunksjon.
Alle opplysningene vil bli oppbevart og behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste, og det vil ikke være mulig å gjenkjenne deg som person. Kun autorisert personell knyttet til prosjektet har adgang til navnelisten og kan finne tilbake til deg. Etter at studien er avsluttet, vil navnelisten bli makulert.
Universitetet i Bergen ved instituttleder er databehandlingsansvarlig. Professor Liv Inger Strand og fysioterapeut Aarid Liland Olsen (PhD stipendiat) vil ha formell tilgang til avidentifiserte data som lagres på universitetets server.

Rett til innsyn og sletting av opplysninger om deg og sletting av prøver
Hvis du sier ja til å delta i studien, har du rett til å få innsyn i hvilke opplysninger som er registrert om deg. Du har videre rett til å få korrigert eventuelle feil i de opplysningene vi har registrert. Dersom du trekker deg fra studien, kan du kreve å få slettet innsamlede prøver og opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige publikasjoner.

Økonomi og Universitetet i Bergens rolle
Universitetet i Bergen gjennom Forskningsgruppe i fysioterapi, Institutt for Global Helse og Samfunnsmedisin, dekker utgifter til bevegelsesgruppen og reiseutgifter ved oppfølgingsundersøkelse i studien. Professor Strand er prosjektleder og har hovedstilling ved UiB og bistilling ved Fysioterapiavdelingen på Haukeland Universitetssjukehus.

Forsikring
Deltakerne er forsikret gjennom Helse–Bergens forsikringsordning som er Norsk Pasientskadeerstatning (NPE).

Informasjon om utfallet av studien
Deltakerne har rett til å få informasjon om utfallet/resultatet av studien. Henvendelse om dette kan rettes til prosjektleder Strand, tlf 55 58 6123 (liv.strand@uib.no).

Samtykke til deltakelse i studien

Jeg er villig til å delta i studien

(Signert av prosjektdeltaker, dato)

Jeg bekrefter å ha gitt informasjon om studien

(Signert, rolle i studien, dato)

APPENDIX 4

The Hip Osteoarthritis Outcome Score (HOOS) questionnaire.

HOOS HIP SURVEY

Today's date: _____/______/______ Date of birth: _____/______/________

Name: ____

INSTRUCTIONS: This survey asks for your view about your hip. This information will help us keep track of how you feel about your hip and how well you are able to do your usual activities.
Answer every question by ticking the appropriate box, only <u>one</u> box for each question. If you are uncertain about how to answer a question, please give the best answer you can.

Symptoms

These questions should be answered thinking of your hip symptoms and difficulties during the **last week**.

S1. Do you feel grinding, hear clicking or any other type of noise from your hip?

Never	Rarely	Sometimes	Often	Always
☐	☐	☐	☐	☐

S2. Difficulties spreading legs wide apart

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

S3. Difficulties to stride out when walking

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Stiffness

The following questions concern the amount of joint stiffness you have experienced during the **last week** in your hip. Stiffness is a sensation of restriction or slowness in the ease with which you move your hip joint.

S4. How severe is your hip joint stiffness after first wakening in the morning?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

S5. How severe is your hip stiffness after sitting, lying or resting **later in the day**?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Pain

P1. How often is your hip painful?

Never	Monthly	Weekly	Daily	Always
☐	☐	☐	☐	☐

What amount of hip pain have you experienced the **last week** during the following activities?

P2. Straightening your hip fully

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

What amount of hip pain have you experienced the **last week** during the following activities?

P3. Bending your hip fully

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P4. Walking on a flat surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P5. Going up or down stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P6. At night while in bed

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P7. Sitting or lying

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P8. Standing upright

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P9. Walking on a hard surface (asphalt, concrete, etc.)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

P10. Walking on an uneven surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Function, daily living

The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your hip.

A1. Descending stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A2. Ascending stairs

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A3. Rising from sitting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A4. Standing

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your hip.

A5. Bending to the floor/pick up an object

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A6. Walking on a flat surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A7. Getting in/out of car

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A8. Going shopping

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A9. Putting on socks/stockings

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A10. Rising from bed

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A11. Taking off socks/stockings

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A12. Lying in bed (turning over, maintaining hip position)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A13. Getting in/out of bath

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A14. Sitting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A15. Getting on/off toilet

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

A17. Light domestic duties (cooking, dusting, etc)

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Function, sports and recreational activities

The following questions concern your physical function when being active on a higher level. The questions should be answered thinking of what degree of difficulty you have experienced during the **last week** due to your hip.

SP1. Squatting

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP2. Running

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP3. Twisting/pivoting on loaded leg

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

SP4. Walking on uneven surface

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Quality of Life

Q1. How often are you aware of your hip problem?

Never	Monthly	Weekly	Daily	Constantly
☐	☐	☐	☐	☐

Q2. Have you modified your life style to avoid activities potentially damaging to your hip?

Not at all	Mildly	Moderately	Severely	Totally
☐	☐	☐	☐	☐

Q3. How much are you troubled with lack of confidence in your hip?

Not at all	Mildly	Moderately	Severely	Extremely
☐	☐	☐	☐	☐

Q4. In general, how much difficulty do you have with your hip?

None	Mild	Moderate	Severe	Extreme
☐	☐	☐	☐	☐

Thank you very much for completing all the questions in this questionnaire.

APPENDIX 5

The BARS-MQE movement quality evaluation form.

Published in:

Skjaerven L, Gard G, Sundal M-A, Strand L. Reliability and validity of the Body Awareness Rating Scale (BARS), an observational assessment tool of movement quality. *European Journal of Physiotherapy.* 2015; Early online:1-10.

With permission.

Appendix 1 Body Awareness Rating Scale, BARS

1: CONTACT WITH THE GROUND (LYING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

2: CLOSING LEGS TOGETHER (LYING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

3: SYMMETRICAL STRETCHING (LYING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

4: ASYMMETRICAL STRETCHING (LYING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

5: SITTING BALANCE (SITTING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

6: UP-DOWN ALONG THE VERTICAL AXIS (STANDING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

7: SIDEWAYS MOVEMENT (STANDING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

8: TURNING AROUND THE VERTICAL AXIS (STANDING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

9: ARM MOVEMENT (STANDING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

10: FLEXING-EXTENDING THE TRUNK (STANDING)

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

11: RELATIONAL MOVEMENT

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

12: WALKING IN A CIRCLE

1 2 3 4 5 6 7

PATIENTS DESCRIPTIONS:

COMMENTS by PT:

Appendix 6

The BARS-MQE movement quality evaluation scoring variables.

Published in:

Skjaerven L, Gard G, Sundal M-A, Strand L. Reliability and validity of the Body Awareness Rating Scale (BARS), an observational assessment tool of movement quality. *European Journal of Physiotherapy.* 2015; Early online:1-10.

With permission.

MQ Score 7	*Very good functional movement quality*: The vertical axis is very well balanced, stable, firm and free. Movement characteristics: Very good functional form, flow, elasticity and rhythm; a very good intentional clarity and direction in the movements. The amount of energy expressed in the movement is very appropriate to the task. The movements originate very clearly from the centre in the trunk. The movements in the person as a whole are simultaneous; they are congruent and in accordance with each other, and are characterized by very good unity and integration. They express a very good movement harmony.
MQ Score 6	*Good functional movement quality*: The vertical axis is well balanced, stable, firm and free. Movement characteristics: Good functional form, flow, elasticity and rhythm; a good intentional clarity and direction in the movements. The amount of energy expressed in the movement is appropriate to the task. The movements originate clearly from the centre in the trunk. The movements in the person as a whole are characterized by good unity and integration. They express a good movement harmony.
MQ Score 5	*Moderate functional movement quality*: The vertical axis is moderately well balanced, stable, firm and free. Movement characteristics: Moderate functional form, flow, elasticity and rhythm; a moderate clarity in the intention and direction of the movements. The amount of energy expressed is moderately appropriately to the task. There are moderate signs of movement originating from the center in the trunk. The movements are characterized by a moderate and variable amount of unity and integration. The movements in the person as a whole are characterized by moderate unity and integration. They express moderate movement harmony.
MQ Score 4	*Some functional movement quality*: The vertical axis has some balance, stability, firmness and freedom. Movement characteristics: Some glimpses of functional form, flow, elasticity and rhythm; some glimpses of intention and direction of the movements. The amount of energy expressed in the movement is somewhat appropriate to the task. There are some signs of movement originating from the centre in the trunk. The movements in the person as a whole are characterized by some glimpses of unity and integration. They express some movement harmony.
MQ Score 3	*Weak functional movement quality*: The vertical axis has an uncertain balance, little stability, firmness and freedom. Movement characteristics: somewhat dysfunctional in form, somewhat mechanical, staccato, stiff, a-rhythmical and lifeless. The movements are characterized by some weakness in the intention and direction. The amount of energy in the movement is more discordant with the task, being smaller and more closed or larger and more open or having too much or too little energy. The movements originate more from the periphery than from the centre in the trunk. The movements are characterized by a weak unity and integration. They express weak movement harmony.
MQ Score 2	*Mostly dysfunctional movement quality*: The vertical axis is mostly lacking balance, stability, firmness and freedom. Movement characteristics: Mostly dysfunctional form, staccato, mechanical, stiff, a-rhythmical, lifeless, mostly lacking elasticity. The movements are characterized by a mostly lacking intention and direction. The amount of energy in the movements is mostly in discord with the task, either being far too small and closed or far too large and open or using far too much or far too little energy. The movements originate mostly from the periphery. There is mostly a lack of unity between upper and lower body. The movements are mostly lacking unity and integration. They express a lack of movement harmony.
MQ Score 1	*Dysfunctional movement quality*. The vertical axis is unstable and fragmented. Movement characteristics: Dysfunctional form, staccato, mechanical, stiff, a-rhythmical, lifeless, lacking elasticity. The movement is characterized by lacking intention and direction. The movements originate from the periphery and are disconnected to each other. The movements in the whole person are in discord, incongruent and counteract each other. They express movement dysharmony.

Appendix 7

The 12 movements in the BARS-MQE movement quality evaluation.

Published in:

Skjaerven L, Gard G, Sundal M-A, Strand L. Reliability and validity of the Body Awareness Rating Scale (BARS), an observational assessment tool of movement quality. *European Journal of Physiotherapy.* 2015; Early online:1-10.

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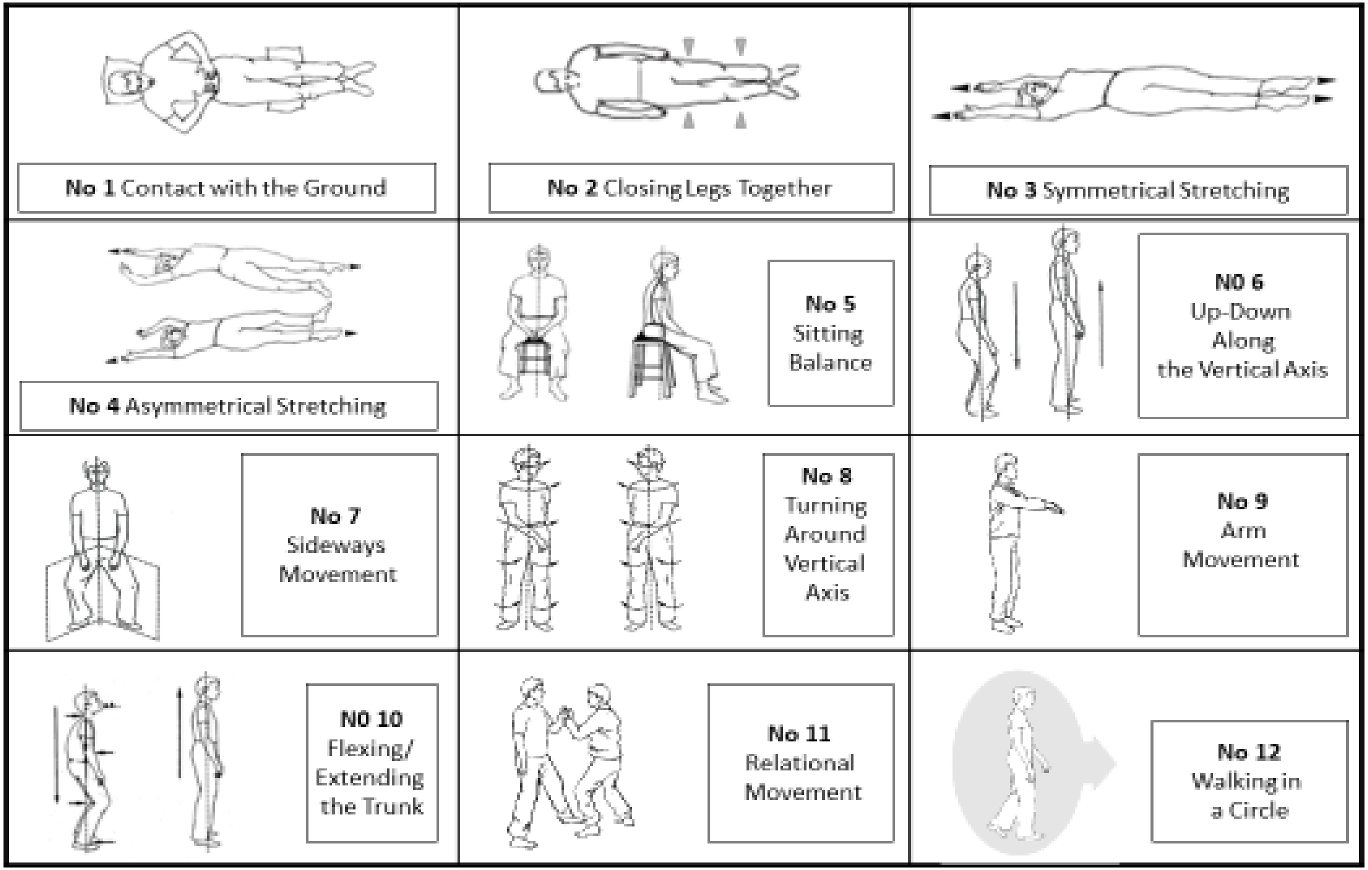

Movement coordinations used in the Body Awareness Rating Scale (No 1-8,10 and 12: Dropsy 1984.
No 9 and 11: Centre for New Media, Bergen University College 2013) Skjærven 2013

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