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RESEARCH ARTICLE

Basic Body Awareness Therapy versus standard care in hip osteoarthritis. A randomized controlled trial

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Abstract

Background: Compensational movement patterns in hip osteoarthritis (HOA) are associated with hip dysfunction. Basic Body Awareness Therapy (BBAT) promotes functional movement quality and might, accordingly, be beneficial in HOA.

Objective: To examine the outcomes of BBAT compared to standard care in people with HOA after first receiving patient education (PE).

Study Design: A prospective, assessor-blinded, and block-randomized controlled trial.

Methods: Community-living adults with HOA participating in PE were randomly allocated to an intervention group receiving BBAT in groups (12 sessions offered once a week), or a comparison group. Data at baseline (pretest) and at 6 months (posttest) were analyzed. Primary outcomes were pain during walking assessed by the Numeric Rating Scale (NRS) and function by the Hip Osteoarthritis Outcome Score, subscale ADL (HOOS A). Secondary outcomes addressed physical capacity, movement quality, and self-reported aspects of function and health.

Results: At pretest, there were no significant differences in demographic and test data between the intervention (n = 51) and the comparison (n = 50) group. Forty-one intervention and 45 comparison participants completed the posttest. At posttest, no significant differences in change between groups were found on NRS (p = 0.694, effect size (ES) = 0.02) or HOOS A (p = 0.783, ES = 0.07). Among secondary outcomes, movement quality improved significantly more (p < 0.001, ES = 0.84) in the intervention group. Compliance with BBAT varied substantially. Per-protocol analysis showed changes in favor of the intervention group for self-efficacy (p = 0.049, ES = 0.36), health (p = 0.037, ES = 0.44), and function (p = 0.029, ES = 0.53) when only intervention participants who completed at least 10 sessions of BBAT were included.

Conclusions: BBAT was not found to be a more effective treatment modality than self-initiated standard care to reduce pain during walking and improve daily

functioning in people with HOA. Movement quality was significantly more improved in participants receiving BBAT, and improvement in other health aspects was associated with sufficient therapy compliance.

KEYWORDS
hip osteoarthritis, learning, movement, physiotherapy, randomized controlled trial

1 | INTRODUCTION

Osteoarthritis (OA) may have consequences for people's physical, social, and personal functioning (Smith et al., 2014; Steinhilber et al., 2014). Physiotherapy guidelines recommend a biopsychosocial approach in standard care, including patient education (PE) and exercise focused on physical health and function (Bannuru et al., 2019). To maintain daily life efficiency, people with hip osteoarthritis (HOA) tend to develop compensational movement patterns with asymmetry and stereotype loading (Constantinou et al., 2014), which in turn may contribute to further OA progression (Schmidt et al., 2017) and muscular dysfunction (Rutherford et al., 2015). Abnormal joint loading during gait in HOA has been found to be associated with self-reported pain and function (Liao et al., 2019). While traditional exercise has not been found effective for changing compensational movement patterns in HOA (Eitzen et al., 2015; Fukumoto et al., 2017; Krauss et al., 2020), the use of specific footwear facilitating gait adjustments in the whole lower limb can result in improved kinematics, pain and function (Solomonow-Avnon et al., 2017). The findings suggest that compensational movement habits might be influenced through harmonizing the interplay between body regions. In the present study, we investigated whether the physiotherapy modality Basic Body Awareness Therapy (BBAT), which is focused on involving the whole person in movement quality practice, can be beneficial for people with HOA.

BBAT is structured to provide participants with insight into their movement habits, increase their awareness of more varied and dynamically adjustable ways of moving, and provide tools to integrate purposeful movement strategies into their daily life setting (Skjaerven et al., 2018; Skjaerven et al., 2010). The movement quality practice is organized around three main movement elements: postural stability, free breathing, and mental awareness, regarded as preconditions for changing stereotype and/or restrictive movement patterns (Skjaerven et al., 2008). The BBAT movements are extracted from basic daily-life movements and include lying, sitting, standing, turning and weight-shift, walking, and relational movements. They are performed slowly and mindful, with sufficient time to become aware of subtle movement nuances for the individual to pursue and develop. Through repetitions, the person accumulates movement experiences, insight and learning. The movement principles in BBAT are derived from Tai Chi, a modality recently included into guidelines for OA physiotherapy (Bannuru et al., 2019). Additionally, a specific movement learning pedagogy is applied in BBAT (Arnold, 1979; Skjaerven et al., 2010), and therapeutic factors for interpersonal learning and support are integrated in BBAT group settings (Yalom, 1995). Finally, to enhance learning, the participants in BBAT are invited to share movement reflections in the therapy session and taught strategies to practice movements at home and integrate them into daily-life actions (Skjaerven et al., 2019).

BBAT has been found beneficial for several long-lasting health problems. Adding BBAT to treatment-as-usual was found effective for pain relief in people with fibromyalgia (Bravo et al., 2018). In adolescents with idiopathic scoliosis, BBAT was found superior to traditional exercise for improved thoracic curve and -rotation (Yagci et al., 2018). Compared with traditional exercise, BBAT was found more effective regarding pain, physical functioning, and social participation in people with chronic whiplash-associated disorders (Seferiadis et al., 2016). Beneficial effects from BBAT on mood, body satisfaction, self-efficacy and independency have been demonstrated in people suffering from various mental health problems (Catalan-Matamoros et al., 2011; Danielsson et al., 2014; Gyllensten et al., 2009). Based on these findings, BBAT might influence physical and psychosocial aspects of functioning also in patients with HOA.

We hypothesized that the implementation of BBAT in HOA would lead to improved postural stability with more nuanced movement patterns and appropriate use of energy and muscular tension, and that these changes would result in reduced symptoms and functional problems. The health-oriented movement pedagogy in BBAT communicates a positive and accepting attitude toward oneself and one's body, thus promoting a constructive symptom management. In a pilot study, we found that participants with HOA improved in function and pain after 12 sessions of BBAT, assessed using measurement instruments (Strand et al., 2016) and described by their own words (Olsen et al., 2017). This supported the relevance of conducting a larger-scale study with a stronger design. The aim of the present study was to examine the effectiveness of BBAT versus self-initiated standard care on pain and function in people with HOA, after both study groups first receiving PE.

2 | METHOD

2.1 | Design overview

A prospective, assessor-blinded, 1:1 allocation ratio, block-randomized controlled trial with a prepost intervention design was conducted. Persons with HOA who were referred and assigned to PE were recruited. The study complies with the Declaration of Helsinki and was approved by the REC Norway (number 2015/1392/REK). The participants gave written informed consent, and the study

protocol was registered in ClinicalTrials.gov (NCT02884531). A complete and updated analysis plan was registered before any analyses were performed (analysis plan). The CONSORT 2010 checklist for reporting a randomized trial (Figure S1) was followed.

2.2 | Participants and randomization

Persons with HOA referred to a PE seminar received written information about the study and were asked to respond yes or no to participation to the daily project manager. *Inclusion criteria*: Women and men with primary HOA according to the American College of Rheumatology Clinical Criteria (Altman et al., 1991), living within reasonable traveling distance. *Exclusion criteria*: Known 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, and pregnancy 5–9 months. The exclusion criteria were screened for in an initial telephone contact.

Before attending the PE, the participants underwent baseline (pretest) assessment by a blinded assessor in accordance with the study protocol. An external researcher provided a computer-generated block randomization schedule (blocks of 4), and opaque envelopes including allocation were prepared by a secretary not otherwise involved in the study. Immediately after each PE seminar, envelopes were handed out to the study participants by the project leader, who was blinded to group allocation and not involved in interventions or assessments. All participants were recommended to follow advice given in the PE, considered as standard care. This included self-initiated exercise and physiotherapy. The intervention participants were offered to join 12 sessions of BBAT, and encouraged to prioritize this movement practice over other physiotherapy in the intervention period.

2.3 | Patient education

The PE was organized monthly as a 3.5 h' seminar. Its content was inspired by a national educational program (AktivA, 2018) for people with hip or knee OA, and led by an orthopedic surgeon and a physiotherapist. Emphasis was put on dialog with the participants, describing the OA disease and treatment options and giving advice on benefits from optimal loading, weight regulation and physical activity/exercises with practical examples. Participants were advised to be physically active and, if needed, obtain physiotherapy in primary health care.

2.4 | Intervention

The intervention participants were offered 12 sessions of BBAT organized in an open group setting once a week, led by a primary care physiotherapist qualified in BBAT. A session consisted of 70 min of guided movements; lying, sitting, standing, walking and relational movements, and 20 min of reflective talk regarding movement experiences. Each month, after PE, new participants joined the running group.

2.5 | Data collection

All data were collected electronically through InfoPad. The minimal hip joint space width (JSW) was measured on pelvic radiographs by the orthopedic surgeon receiving referrals to PE. Participant characteristics (age, sex, body mass index, and JSW) were registered at pretest, and data from four physical assessments and six self-report questionnaires were registered at pre- and posttest. At posttest 6 months after baseline, the participants additionally filled in the Patient Global Impression of Change (PGIC) regarding pain and function, and registered any physiotherapy received since the pretest. All assessments were conducted at the University of Bergen, by the same physiotherapist blinded to group allocation. Self-report questionnaires were filled in electronically after 12 months for use in a study of long-term outcomes.

2.6 | Outcome measures

Primary outcomes were Numeric Rating Scale (NRS) assessing pain during walking and the Hip Osteoarthritis Outcome Score (HOOS), subscale A, assessing function in daily life. Secondary outcomes were physical capacity, movement quality, and self-reported health and function. The outcome measures are described in Table 1.

2.7 | Data analysis

2.7.1 | Sample size and missing values

Based on previous studies using NRS for pain assessment (Farrar et al., 2001; Tubach et al., 2005), we calculated the required sample to be 44 in each group to detect a clinically important improvement (MCII) of 1.53 points (SD = 3, power = 80% and $\alpha = 0.05$). Allowing for a 15% dropout, a total of 100 participants was required. As to HOOS A, referring to power calculation of previous studies (Hermann et al., 2016; Villadsen, 2016), 74 participants were needed to detect an MCII of 10 points (SD = 15, power = 0.80). A total of 100 participants was, accordingly, considered sufficient for both measures.

2.7.2 | Statistical analysis

Normal distribution of scores was confirmed through inspection of histograms and Q–Q plots. Intention-to-treat analysis was used to examine changes in primary- and secondary outcomes from

TABLE 1 Description of assessment tools used in the study

Outcome measure	Construct and scores	Measurement properties
Numeric rating scale (NRS)[a]	The participants marked one number reflecting their pain during walking over the previous two weeks, using the scale 0 (no pain) −10 (worst pain possible)	Excellent test–retest reliability (ICC = 0.95) in knee OA (Alghadir et al., 2018). A change ≥15.3 mm on a 0–100 scale considered clinically important in HOA (Tubach et al., 2005)
Hip osteoarthritis outcome score (HOOS) HOOS A[a] HOOS P[b], S[b], SP[b], and QL[b]	Physical function over the previous week related to five HOOS domains; pain (P), symptoms (S), activities of daily life (A), sport and recreation (SP), and quality of life (QL) (Klassbo et al., 2003). The sum score of each domain is transformed to a normalized scale, 0–100 (extreme to no problems)	High test–retest reliability (ICCs 0.78–0.91) (Klassbo et al., 2003)
Chair test (sit-to-stand)[b]	Rising from a chair and sitting down for 30 s; counting number of repetitions	High test–retest reliability (ICC = 0.85) (Dobson et al., 2017). 2.0–2.6 repetitions regarded a clinical important improvement (Wright et al., 2011)
Stairs test[b]	The time (seconds) used to walk up and down 18 steps × 3 is measured (Tveter et al., 2014)	
6-min walking test (6MWT)[b]	Walking as far as possible in 6 min, distance measured in meter.	High test–retest reliability (ICC > 0.90), minimal detectable change (MDC) 50.2 m (Dobson et al., 2017)
Body Awareness Rating Scale–Movement Quality and Experience (BARS-MQE)[b]	Observed movement quality in 12 movement items scored from 1 (dysfunctional movement quality) to 7 (very good functional movement quality), the sum score ranging from 12 to 84 (Skatteboe, 2005)	High test–retest reliability, ICC = 0.96, MDC = 3.3 points (L. Skjaerven et al., 2015)
University of California Los Angeles activity score (UCLA)[b]	Self-reported level of physical activity during the last month scored on a 10 points ordinal scale from totally sedentary to participating regularly in high intensity physical activities (Naal et al., 2009)	Criterion validity is indicated (Zahiri et al., 1998). Excellent test–retest reliability (Kw = 0.80) and discriminative validity in HOA reported (Naal et al., 2009)
Arthritis Self-efficacy Scale (ASES)[b]	A questionnaire about self-efficacy in people with arthritis. The sub-categories pain and symptoms used in this study, consist of 5 and 6 questions, respectively, each to be answered on a 5-point Likert scale. Sum-score (worst-to-best) of sub-category pain is 5–25 and of symptom 5–30	High test–retest reliability (r = 0.87 for pain and 0.90 for symptoms) (Lorig et al., 1989)
EuroQol (EQ-5D-5L)[b]	A generic health index comprising a five-part questionnaire and a visual analog self-rating scale. 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 0–100 scale with the endpoints "best/worst imaginable health state."	Test–retest reliability has been reported (ICC ranging 0.61–0.77) (Conner-Spady et al., 2015)
Harris hip score (HHS)[b]	An assessment tool of hip disability, combining the participant's self-reported pain and function with the physiotherapist's observation of movement range	Excellent test–retest reliability (r = 0.93) (Soderman & Malchau, 2001). A change of 16.8 points regarded clinically important (Hoeksma et al., 2003)
Patient Global Impression of change (PGIC)[b]	The participants' own impression of change in pain and function after the intervention period. Change is scored on a seven-point ordinal scale: 1 very much worse, 4 no change, 7 very much improved (Lauridsen et al., 2007)	

Abbreviations: HOA, hip osteoarthritis; OA, Osteoarthritis.

[a]Primary outcomes.

[b]Secondary outcomes in the present study.

pre-to-posttest in participants who completed both assessments. To compare between-group changes, we used analysis of covariance (ANCOVA) with the posttest value of each outcome measure depending on groups allocation and adjusted for its pretest value. Results regarding the groups (called A and B) were discussed and agreed upon before breaking the randomization code. Paired samples *t*-tests were used to examine within-group changes. Independent *t*-tests were used to compare changes on PGIC pain and function between groups. Effect sizes (Cohen's *d*) were calculated. The general significance level was set at 0.05. Using Bonferroni adjustment for the two primary outcomes NRS and HOOS A, 0.025 was set as a marginal level. Based on a previous study, 10 sessions of BBAT seem sufficient to induce statistically significant improvement in movement quality as evaluated by the BARS-MQE (Friis et al., 1989). Accordingly, participants of the present study who attended at least 10 of the total 12 BBAT sessions were regarded compliers and included in

TABLE 2 Demographic and test variables at pretest of participants in the intervention group, the comparison group, and participants lost to follow-up

	Intervention group (PE + BBAT)		Comparison group (PE)			
Variables	*n*	Mean (SD), min–max	*n*	Mean (SD), min–max	Lost to follow-up (*n* = 15) mean (SD)	Difference (included vs. lost) mean, *p*-value
Demographic variables						
Sex; female, *n* (%)	51	40 (78)	50	40 (80)	13 (87)	-
Age, years	51	64.8 (9.3), 44–83	50	61.3 (12.0), 23–78	60.3 (15.1)	3.3, 0.281
Body mass index (BMI)	51	25.8 (3.7), 19.7–35.5	50	25.4 (3.6), 19.3–32.3	26.2 (3.5)	−0.7, 0.521
Joint space width, mm	45[a]	1.5 (1.0), 0–4	46[a]	1.8 (1.0), 0–4	1.2 (1.0)	0.5, 0.095
Observational movement quality analysis						
BARS-MQE total, scale 12–84 (best)	51	45.8 (7.2), 27–60	50	47.4 (5.7), 34–59	44.4 (4.6)	2.5, 0.164
Physical tests						
Chairs test, number in 30 s;	51	13.4 (4.6), 0–24	50	14.7 (4.70), 5–23	14.8 (4.1)	−0.9, 0.506
Stairs test, s	51	64.2 (27.8), 34.2–154.3	50	56.1 (17.7), 31.1–120.6	68.6 (30.8)	−9.8, 0.136
6MWT, m/6 min	51	481.8 (103.4), 210–804	50	505.6 (104.0), 323–765	475.1 (104.1)	21.6, 0.459
Questionnaires						
NRS pain in walking, scale 0–10 (worst)	50[b]	3.9 (1.8), 0–8	50	4.3 (2.08), 0–9	4.2 (2.6)	−0.2, 0.784
ASES pain, scale 5–25 (best)	51	16.7 (5.1), 5–25	50	17.6 (4.6), 6–25	14.9 (5.9)	2.7, 0.048
ASES symptoms, scale 5–30 (best)	51	22.9 (4.8), 10–30	50	22.6 (4.4), 11–30	21.3 (5.3)	1.7, 0.188
EQ-5D-5L, index 0–1 (best)	51	0.7 (0.1), 0.1–1.0	50	0.7 (0.1), 0.3–0.8	0.6 (0.2)	0.1, 0.174
EQ-5D-5L, VAS 0–100 (best)	51	65.7 (16.9), 20–90	50	72.0 (15.3), 39–97	63.1 (22.5)	6.7, 0.142
HOOS P, scale 0–100 (best)	51	56.6 (16.9), 13–88	50	58.2 (15.9), 28–88	50.1 (16.8)	8.6, 0.061
HOOS S, scale 0–100 (best)	51	50.7 (19.3), 15–90	50	50.9 (21.5), 15–100	41.0 (21.1)	11.5, 0.043
HOOS A, scale 0–100 (best)	51	67.4 (16.0), 29–99	50	67.2 (18.4), 29–100	63.4 (17.6)	4.5, 0.350
HOOS SP, scale 0–100 (best)	51	53.1 (19.9), 6–94	50	57.9 (20.1), 19–100	50.5 (23.9)	5.8, 0.304
HOOS QL, scale 0–100 (best)	51	48.7 (16.9), 13–81	50	44.0 (16.1), 0–75	36.3 (18.9)	11.8, 0.010
UCLA, scale 1–10 (best)	51	5.9 (2.0), 3–10	50	6.6 (2.3), 2–10	5.9 (1.7)	0.5, 0.414
HHS sum score, scale 0–100 (best)	50[b]	70.1 (12.7), 44–96	50	69.8 (10.8), 42–96	65.8 (10.2)	4.8, 0.154

Note: Difference between included and lost participants.

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 index and VAS scale; HHS, Harris Hip Score; 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.

[a]Images from 10 participants not available.

[b]Data from one participant lacking due to technical problem.

a per-protocol analysis. The computation was done using SPSS 26 (IBM Corp.) and R 3.6 (R Core Team, 2020), and the graphics was created using Matlab9.0 (The Mathworks Corp.).

3 | RESULTS

3.1 | Flow of participants and adherence to study protocol

From October 2015 to January 2019, 176 persons were invited to participate in the study and 101 accepted. Pretest characteristics of 51 intervention and 50 comparison participants are presented in Table 2, showing great heterogeneity, but no difference between groups. The median time period from pre-to-posttest was 5.6 months. Ten (20%) intervention participants and 5 (10%) comparison participants were lost to follow-up, see flowchart (Figure 1). Eighty-six participants were, accordingly, included in intention-to-treat analysis. The intervention participants attended a mean of 10 (SD = 2.1) BBAT sessions, ranging from 4 to 12. About 30 persons were found to be compliers of BBAT and included in the per-protocol analysis. Twenty-seven comparison and six intervention participants had attended a mean of 17 (SD = 11) and 11 (SD = 7) sessions, respectively, of self-initiated physiotherapy (standard care). Less than 10% of

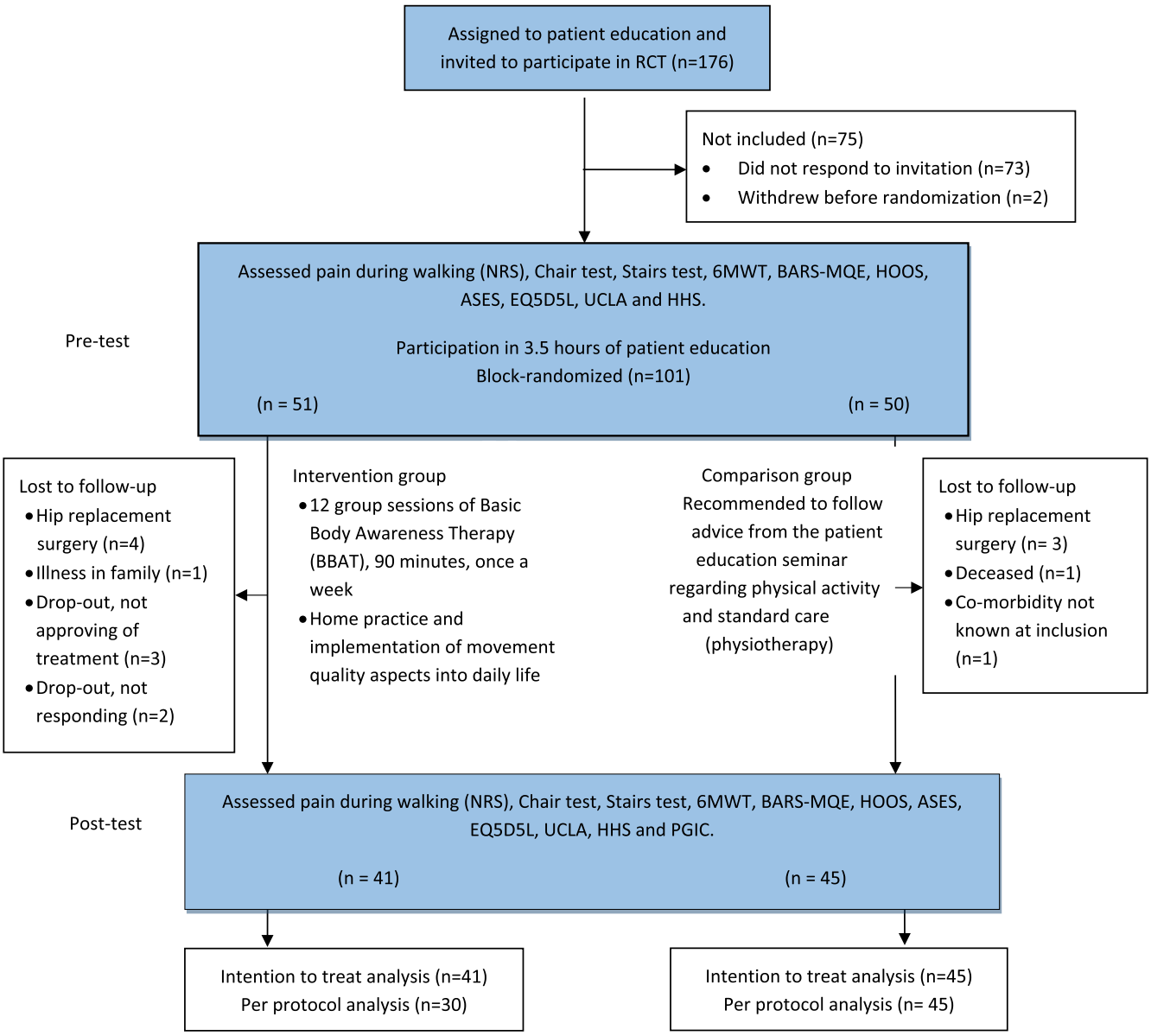

FIGURE 1 Design and flow of participants through the trial. 6MWT, 6-min walk test; ASES, Arthritis Self-efficacy Scale; BARS-MQE, Body Awareness Rating Scale–Movement Quality and Experience; EQ5D5L, EuroQol index and scale; HHS, Harris Hip Score; HOOS, Hip Osteoarthritis Outcome Scale; NRS, Numeric Rating Scale; PGIC, Patient Global Impression of Change; UCLA, University of California Los Angeles Activity Score

single questionnaire items were missing. Those were handled by mean imputation. One comparison participant declined to perform the physical tests at posttest, due to severe pain. No adverse events were reported.

3.2 | Effects of intervention

3.2.1 | Primary outcomes

No effect of the treatment was shown on NRS pain during walking and HOOS A at posttest, neither in intention-to-treat (Figure 2) nor in per-protocol analyses (Figure S1). No significant improvement was found in either group (Table 3).

3.2.2 | Secondary outcomes

In intention-to-treat analysis, effect of treatment was found only in movement quality (BARS-MQE), with a large effect size, see Figure 3. This effect was somewhat stronger in per-protocol analysis, in which we found effects in health (EQ5D5L VAS, $p = 0.037$), function (HHS, $p = 0.029$) and self-efficacy (ASES pain, $p = 0.049$) with moderate effect sizes (Table S1 and Figure S2). Intervention participants reported more improvement on PGIC for pain ($p = 0.03$) than comparisons and tended to report more improvement also on PGIC for function ($p = 0.07$). A responder analysis based on the PGIC was planned, but later considered inappropriate due to the small change scores found in the study groups.

4 | DISCUSSION

Our study is the first randomized controlled trial to investigate effects of BBAT in people with HOA. In contrast to the promising findings in our pilot study (Strand et al., 2016), we found that adding BBAT to PE did not result in more pain relief during walking or increased function in daily life activities. These were our primary outcomes. Movement quality, evaluated by BARS-MQE, was significantly more improved in the intervention than the comparison group, showing that the intervention participants improved in the functional aspect that was focused on in therapy. However, only when the participants complied sufficiently with the therapy, the improved movement quality had an impact on other aspects of health and functioning, requiring at least 10 sessions.

One possible explanation why the results of the present RCT differ from those of the pilot study, might be the divergent pretest characteristics in the two groups. While the pilot participants had

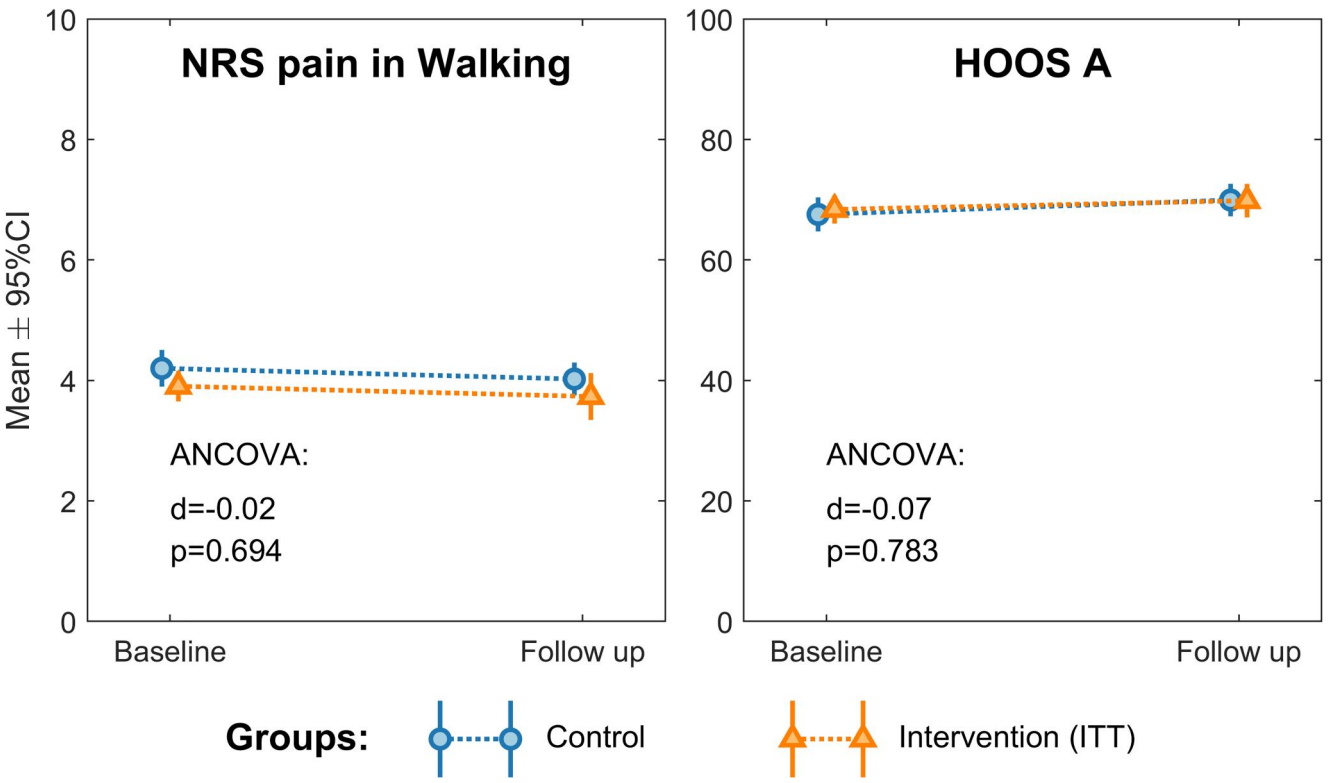

FIGURE 2 Change within groups (Cohen's *d* for effect size) and between groups (analysis of covariance [ANCOVA] *p*-value) on primary outcomes Numeric Rating Scale for pain during walking and Hip Osteoarthritis Outcome Score subscale A, in intention-to-treat analysis

TABLE 3 Changes in the intervention (PE + BBAT) group and the comparison (PE) group from pre-to-posttest

	PE + BBAT			PE		
Measures	***n***	**Change[a] mean (SD)**	**Paired *t*-test *p*-value**	***n***	**Change[a] mean (SD)**	**Paired *t*-test *p*-value**
NRS walking	41	0.17 (2.14)	0.613	45	0.18 (2.52)	0.638
HOOS A	41	1.45 (13.27)	0.487	45	2.39 (12.57)	0.210
BARS-MQE	41	5.06 (5.96)	**<0.001**	44	0.48 (3.92)	0.424
Chair test	41	1.32 (3.73)	**0.029**	44	1.27 (4.09)	**0.045**
Stairs test	40	0.51 (12.32)	0.794	44	1.16 (11.30)	0.500
6MWT	41	−3.76 (115.17)	0.836	44	7.61 (75.13)	0.505
ASES pain	41	−0.59 (4.14)	0.371	45	−1.78 (4.82)	**0.017**
ASES sympt.	41	−0.44 (4.06)	0.492	45	−0.20 (4.67)	0.775
EQ5D5L index	41	0.03 (0.18)	0.262	45	0.03 (0.12)	0.145
EQ5D5L VAS	37	2.95 (15.25)	0.248	43	−4.44 (18.86)	0.130
HOOS P	41	4.81 (14.28)	**0.037**	45	1.17 (12.68)	0.540
HOOS S	41	4.15 (16.84)	0.123	45	1.67 (14.54)	0.446
HOOS SP	41	0.90 (17.77)	0.748	45	−0.69 (16.77)	0.784
HOOS QL	41	2.89 (12.34)	0.141	45	2.60 (14.67)	0.241
UCLA	41	0.07 (1.68)	0.782	45	0.22 (2.00)	0.460
HHS	41	7.54 (15.48)	**0.003**	44	2.54 (12.48)	0.183

Note: The two measures in bold (NRS walking and HOOS A) represent our primary outcome measures. The numbers in bold represent differences between groups that are found to be statistically significant.

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 index and VAS scale; HHS, Harris Hip Score; 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.

[a]Positive value means improvement.

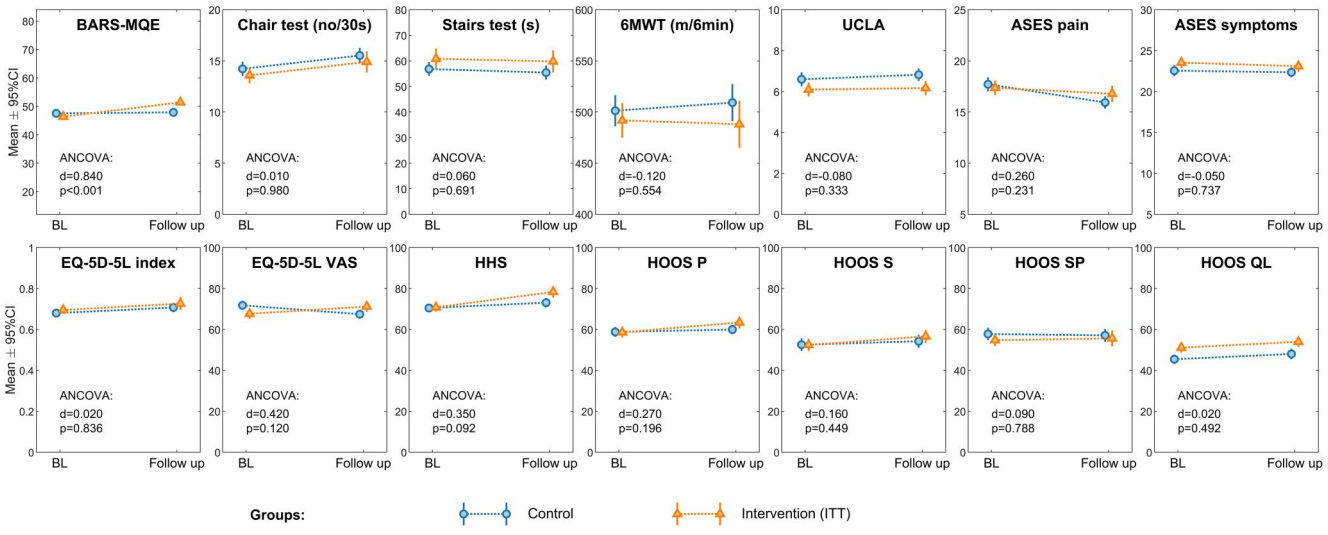

FIGURE 3 Change within groups (Cohen's *d* for effect size) and between groups (analysis of covariance [ANCOVA] *p*-value) on secondary outcomes (Body Awareness Rating Scale—Movement Quality and Experience, Chair test, Stairs test, 6-min walking test, Arthritis Self-efficacy Scale for Pain and Symptoms, EQ5D5L index and VAS scale, University of Los Angeles Activity Score, Harris Hip Score and Hip Osteoarthritis Outcome Score subscales P, S, SP, and QL, in intention-to-treat analysis)

severe HOA and were all highly motivated for an alternative to hip replacement surgery, a considerable number of participants in the RCT presented with rather good scores on the primary outcomes, implying that there was less room for improvement. This might have weakened the statistical power of our analyses and the possibility to detect change. To ensure a potential for change, minimum scores of pain and disability could have been added to our inclusion criteria (Fitzgerald et al., 2015).

Another difference between the two studies was the therapy compliance. All but one pilot participant attended 12 BBAT sessions, whereas compliance with BBAT was weaker in the present study. Only 30 of 41 participants attended 10–12 sessions, and there were more dropouts in the intervention group ($n = 10$) than in the comparison group ($n = 5$). This might be due to a difference in group structure. While the pilot group was closed and allowed for participants to develop familiarity, interpersonal support and a sense of belonging, the RCT group took in new members every month. The group was very small (two to three participants) in periods of slow recruitment. This probably disrupted the group dynamic and weakened the participants' motivation to complete the full treatment. Participants who experienced improvement probably complied better than those who did not. In BBAT theory, 10 treatment sessions are regarded to be a minimum for changing body image, muscular tension and movement patterns (Roxendal, 1985). This was supported by our findings of stronger improvement in participants who attended 10 sessions or more.

The participants in the comparison group attended a high number of physiotherapy sessions. This can be regarded a positive effect of PE, indicating that participants were inspired to try out other non-surgical treatment if they were not randomized to BBAT. Regardless of type, the therapy probably had some beneficial effects on pain and function and thereby reduced the difference in change between the study groups.

In our study, pain (NRS) and function (HOOS A) were chosen as the primary outcomes because they have been described by people with HOA as essential (Smith et al., 2014), and have been used in previous studies evaluating effects from physiotherapy (Goh et al., 2019). The mechanisms behind exercise induced effects on pain and function in OA are, however, debated. According to a literature study (Beckwee et al., 2013), improvements might be associated with physical and psychosocial components. Many of the identified components are implemented in BBAT movements, such as proprioception, tissue flexibility and springiness, stability and interpersonal and psychosocial learning. As hypothesized, the intervention participants in our study were inclined to report more improvement on pain and function on PGIC, but this was not reflected in improvement by NRS and HOOS A scores. In a study of correlations between baseline scores in our study sample, we found only weak associations between movement quality (BARS-MQE) and NRS and HOOS A (Olsen et al., 2020), which indicates that other primary outcomes might have been more suitable to capture changes related to improved movement quality from BBAT.

4.1 | Limitations

A main limitation of this study was the heterogeneity in pretest characteristics, meaning that people with rather good primary test scores were included, but were not likely to demonstrate improvement. Future researchers might consider defining and investigating subgroups of people with HOA, based on actual symptoms and functional problems.

As dropouts were excluded from the analyses of change, we did not conduct a true intention-to-treat analysis. The number of dropouts was, however, accounted for in the power calculation. Their pretest scores were similar to those of the included participants (Table 2), and we could not find a relation to the outcome values, that is they were considered to be missing at random.

Due to recruitment delay, some participants had to wait before joining the BBAT group, and the intervention period was extended for the individual patient due to sickness, holidays and/or vacations. These circumstances lead to a longer intervention period (median 5.6 months) than planned (4 months). The delay might represent a bias, allowing for a longer period of physiotherapy for some of the comparison participants.

4.2 | Implications for physiotherapy practice

While the findings indicate that participation in open BBAT groups is not superior to standard care, BBAT seems comparable and a viable option to reduce pain and increase function in HOA. BBAT could be preferred when increasing movement quality is a goal, and the choice of treatment might be guided by the individual's motivation and preferences. Motivation might be better obtained in closed BBAT groups with an appropriate number of participants. We found that participants who complied well with BBAT improved more on several aspects of health, and the choice of primary outcomes should therefore be reconsidered in future studies.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS STATEMENT

The study complies with the Declaration of Helsinki and was approved by the REC Norway (number 2015/1392/REK).

AUTHOR CONTRIBUTIONS

Data collection, data analysis and interpretation, drafting the article, approving of the final version: Aarid Liland Olsen. *Data interpretation, critical revision of the article and approval of the final version*: Liv Heide

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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