Original paper

Assessing the impact of a long-term physiotherapy program on hip function in patients with osteoarthritis: the role of patient-reported and assessor-observed outcome measures

Ocena wpływu długoterminowego programu fizjoterapii na czynność stawu biodrowego u pacjentów z chorobą zwyrodnieniową stawów: rola miar wyników raportowanych przez pacjenta i obserwowanych przez oceniającego

Agnieszka Lewińska[1], Piotr Palczewski[2], Andrzej Cieszanowski[3], Witold Rongies[4]

[1]Chair of Clinical Physiotherapy, Faculty of Rehabilitation, Józef Piłsudski University of Physical Education, Warsaw, Poland
Head of the Chair: Grażyna Brzuszkiewicz-Kuźmicka PT, PhD
[2]1st Department of Clinical Radiology, Faculty of Medicine, Medical University of Warsaw, Warsaw, Poland
Head of the Department: Prof. Marek Gołębiowski MD, PhD
[3]2nd Department of Clinical Radiology, Faculty of Medicine, Medical University of Warsaw, Warsaw, Poland
Head of the Department: Magdalena Januszewicz MD, PhD
[4]Department of Rehabilitation, Faculty of Dental Medicine, Medical University of Warsaw, Warsaw, Poland
Head of the Department: Dariusz Białoszewski MD, PhD

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Słowa kluczowe: choroba zwyrodnieniowa stawów, rehabilitacja, staw biodrowy, testy aktywności, miary wyników zgłaszane przez pacjentów.

Abstract

Introduction: Because there are few trials evaluating rehabilitation effects in people with hip osteoarthritis, it is important to increase the body of research and develop assessment methods improving the objectivity of evaluation.
Aim of the research: To evaluate the effect of a long-term, land-based physiotherapy program on the hip-related function in patients with hip osteoarthritis, and to assess the relationship of self-reported and assessor-observed functional outcome measures.
Material and methods: The trial was conducted prospectively over a 12-month period. The study cohort consisted of 37 people of both genders. The intervention included three rounds of 3-week physiotherapist-supervised treatment and two 5-month intervals of an unsupervised maintenance program in between. The functional assessment was performed 4 times using the Hip Dysfunction and Osteoarthritis Outcome Score (HOOS) and a set of performance-based tests (PBTs): the 30-Second Chair Stand Test (30secCST), 40-Metre Fast-paced Walk Test (40mFPWT), and Stair Climb Test (SCT). The hip joint was evaluated twice structurally using the Scoring Hip Osteoarthritis with MRI (magnetic resonance imaging).
Results: A significant improvement in hip-related function was observed in HOOS among MRI progressors, exclusively physical workers. Non-progressors, mostly sedentary workers, were characterized by improvement of PBTs. There was a correlation between HOOS and 40mFPWT and SCT at the baseline, 3-week, and 6-month follow-ups. The outcomes for 30secCST were not consistent. We observed a positive effect of rehabilitation on hip function in the studied population, although progressors and non-progressors achieved different outcomes. The relationship of PBTs and HOOS was marked, but not unequivocal.
Conclusions: The improvement in self-reported measures may mask disease progression in MRI progressors.

Streszczenie

Wprowadzenie: Ze względu na to, że istnieje niewiele badań oceniających efekty rehabilitacji u osób z chorobą zwyrodnieniową stawu biodrowego, ważne jest rozszerzenie zakresu badań i opracowanie metod oceny poprawiających jej obiektywność.
Cel pracy: Ocena wpływu długoterminowego programu fizjoterapii na funkcję stawu biodrowego u pacjentów z chorobą zwyrodnieniową stawów biodrowych oraz ocena związku raportowanych przez pacjenta i ocenianych przez obserwatora funkcjonalnych miar efektu.
Materiał i metody: Badanie prowadzono prospektywnie na przestrzeni 12 miesięcy. Grupa badana składała się z 37 osób obojga płci. Interwencja obejmowała trzy 3-tygodniowe serie nadzorowanego postępowania fizjoterapeutycznego oraz dwa 5-miesięczne okresy nienadzorowanego programu podtrzymującego. Ocenę funkcjonalną przeprowadzono czterokrotnie, przy użyciu specyficznego dla stawu biodrowego kwestionariusza *Hip dysfunction and Osteoarthritis Outcome Score* (HOOS)

oraz zestawu testów aktywności: testu 30-sekundowego wstawania z krzesła (30secCST), testu 40-metrowego szybkiego chodu (40mFPWT) i testu wejścia po schodach (SCT). Strukturalnie staw biodrowy był oceniany dwukrotnie, z wykorzystaniem obrazowania metodą rezonansu magnetycznego i półilościowego systemu oceny stawu biodrowego *Scoring Hip Osteoarthritis with MRI*.
Wyniki: Istotną poprawę funkcji zaobserwowano w HOOS wśród osób z progresją choroby, wyłącznie pracujących fizycznie. Osoby ze stabilną postacią choroby, głównie osoby wykonujące pracę siedzącą, charakteryzowały się poprawą w zakresie PBTs. Wystąpiła korelacja między HOOS a 40mFPWT i SCT wyjściowo, po 3 tygodniach i po 6 miesiącach. Wyniki dla 30secCST nie były spójne. Zaobserwowano pozytywny wpływ rehabilitacji na funkcję stawu biodrowego w badanej populacji, chociaż osiągane wyniki były rozbieżne, w zależności od obecności progresji choroby. Wykazano związek pomiędzy PBTs i HOOS, ale nie jest on jednoznaczny.
Wnioski: Subiektywna poprawa funkcji może maskować postęp choroby u osób z progresją choroby.

Introduction

Osteoarthritis (OA) is considered the most common musculoskeletal disease worldwide, incurring massive social and medical costs [1]. These include both the direct healthcare costs (hospital admissions, diagnostic examinations, pharmacological and surgical therapy) and indirect costs like losses in productivity caused by absence from work or premature retirement, which surpass the direct financial burden on health care [2]. According to the Global Burden of Disease Study 2017, symptomatic OA is responsible for approximately 118.9 years lived with disability (YLDs) per 100,000 population, which amounts to an overwhelming 9.6 million YLDs globally. The same study showed a significant worldwide increase in OA prevalence between the years 1990 and 2017 [3].

Conventional treatment of OA consists of pain management in the earlier stages and joint arthroplasty for the end-stage disease, with the latter representing a major proportion of the medical costs [4]. Thus, there is a need to develop effective interventions capable of minimizing the impact and slowing the progression of OA, especially postponing the need for arthroplasty.

Rehabilitative interventions are considered the first line of treatment for OA, but the data suggest that only the minority of OA patients with clinical indication for physiotherapy are recommended such interventions [5, 6]. The clinical and cost effectiveness of physiotherapeutic treatment indicates that it should be applied more widely, especially considering the proven reduced risk of total hip or knee replacement in patients who underwent physiotherapy soon after receiving an OA diagnosis [7, 8].

Conservative treatment recommendations acknowledge employing a wide range of procedures, but the core management concentrates on the area of physical activity [9–11]. Although there is substantial proof of the usefulness of exercise therapy, the most effective types of exercise for given sub-populations and the therapeutic dose required for clinical improvement are not universally agreed on [12, 13]. A combination of different types of exercise appears to be preferable [14].

OA rehabilitation research invariably continues to focus on the knee joint, but a better understanding of the rehabilitation impact on other joints affected by OA could help to determine optimal prescription and delivery of exercise therapy and develop methods that promote long-term exercise adherence and facilitate behavioural changes [15, 16]. Because there are few trials evaluating rehabilitation effects in people with hip OA (HOA), it is important to increase the body of research and develop assessment methods improving the objectivity of evaluation of rehabilitation effects, especially long-term effects [17].

There are multiple outcome measures recommended in OA research, depending on the nature of the conducted study. In general, pain, function, and QOL can be considered a core set of clinically meaningful outcomes to be assessed in HOA interventions, and there are a number of instruments used to evaluate these domains either from the patient's or assessor's perspective [18, 19].

This paper describes the effect a land-based physiotherapy has on the hip-related function in patients with HOA.

Aim of the research

The aim was to investigate the subjective and objective functional status of patients with HOA, observed in the consecutive time points of a long-term physiotherapy program. Additionally, the relationship between self-reported questionnaire and assessor-observed performance-based tests (PBTs) was examined.

Material and methods

The whole trial was conducted prospectively. The intervention was a long-term physiotherapy program. Hip-related function was studied as well as the whole joint structural changes. The structural hip joint evaluation was performed with the use of semi-quantitative magnetic resonance imaging MRI-based scoring system – Scoring Hip Osteoarthritis with MRI (SHOMRI) [20]. The structure-related outcomes are described in detail in another paper [21]. Enrolment of patients and completion of the study is demonstrated in the flow chart in Figure 1.

The study obtained the approval of the Bioethics Committee of Medical University of Warsaw (KB/189/2014, date of approval: 7 September 2014) and was registered on the Australian New Zealand Clinical Trials Registry (ACTRN12621000489897).

Participants

The participants were recruited from consecutive first-time patients of the Department of Rehabilitation of Central Teaching Clinical Hospital of Medical University of Warsaw, Poland. After the enrolment of the participants the inclusion eligibility was initially assessed using a preliminary questionnaire. The study cohort consisted of 37 people of both genders who met the inclusion criteria. Patients had the right to withdraw from the study at any time with no need to provide a reason for withdrawal.

At baseline, descriptive information regarding the overall health status, medication use, co-morbidities, duration of HOA symptoms, and demographic factors including age, gender, body mass index (BMI), and occupation were obtained via questionnaire. Disease severity was assessed from hip radiographs and classified using the Kellgren-Lawrence grading system (K-L) [22]. Overall average hip pain during the past week was assessed using a 0–10 numerical rating scale (NRS).

Eligibility criteria for participants included: age over 18 years; hip osteoarthritis fulfilling American College of Rheumatology classification criteria [23]; hip joint weight bearing plain radiography within 6 months; and written informed consent. Exclusion criteria included contraindications for MRI, physical therapy treatment, or physical activity; systemic arthritic conditions or diseases and lesions within the musculoskeletal system other than HOA that could significantly affect the condition of the hip joint and the patient's functional capabilities; prior hip surgery or lower extremity joint replacement; intra-articular corticosteroid injection or oral steroid or non-steroid anti-inflammatory drugs (NSAID) chronic use within 6 months; viscosupplementation within 6 months; prior cerebral vascular accident or other neurological disorders affecting sensorimotor functions; history of myocardial infarction; history of cancer; and general poor health status.

For the purpose of statistical analysis, the subgroups of progressors (*n* = 7) and non-progressors (*n* = 17) were distinguished from patients who completed the study based on the features of structural deterioration observed in MRI. All progressors had a physical occupation, while the occupational activity of all but 2 non-progressors was sedentary.

Rehabilitation protocol

The subjects participated in 3 rounds of 3-week physiotherapist-supervised treatment at the rehabilitation outpatient clinic, performed 5 days a week. There were two 5-month intervals of an unsupervised home-based maintenance program in between. The supervised rehabilitation program focused on pain reduction, active range of motion (ROM) improvement, and obtaining proper muscle control. The duration of the intervention period was 12 months. Each supervised exercise session lasted approximately 90 min. The session consisted of the symptomatic hip joint traction procedure followed by hip suspension exercises. Then, lower extremity muscle strengthening and proprioception training was conducted. Additionally, to provide an analgesic effect, transcutaneous electrical nerve stimulation (TENS) was applied.

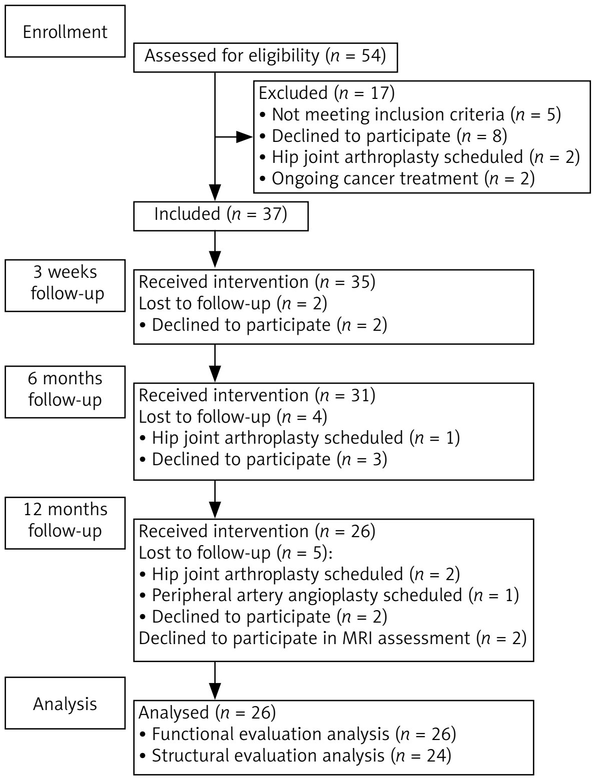

Figure 1. Patients' enrolment and completion

The hip traction was performed mechanically with use of pulleys, weights, and cords, according to the standard protocol used in the clinic. The patient was placed in a supine position with the hip joint slightly flexed, abducted, and externally rotated and the knee joint slightly flexed. A force was applied above the knee, in the lower third of femur, and directed along the long axis of the femur and/or femoral neck, depending on the joint space narrowing pattern. The 3-kg weight initially used was increased daily until a load of 10% of body mass was achieved, corresponding to forces between approximately 80 and 100 N. In case of discomfort, the weight was reduced and maintained at a level that was well tolerated by the patient. The hip traction lasted 30 min.

Hip suspension exercises were open-chain exercises conducted in the sagittal and frontal planes with the use of cords and straps.

Lower limb strengthening exercises were performed using elastic bands of progressive resistance. Emphasis was placed on the hip abductors and extensors. The intensity of training was based on the estimation of maximal weight that can be lifted only once through the whole available range of motion (one-repetition maximum, 1RM) and executed with the use of elastic bands. After positioning the patient and giving appropriate instructions, a random initial load, close to the suspected maximum, was applied and increased or decreased following the patient's capacity to perform one repetition. To obtain intensity sufficient to improve muscle strength, protocol with an intensity equalling 60% of 1RM was used, according to the recommendations of the American College of Sports Medicine. One to three sets of 8–12 repetitions of each exercise were performed [24]. The patients performed the exercises in the supine, side lying, and standing positions.

Proprioception exercises for the lower limbs were performed in the supine and standing positions. Elastic bands, inflated balls, and cushions with adjustable air pressure were used for training.

The patients were also advised to perform a set of strengthening, proprioception, and ROM exercises at home.

Electrical stimulation was delivered using 2 flat silicon electrodes of size 70 × 70 mm (E-S 50, EiE, Otwock, Poland), applied bilaterally. The TENS setting was in a conventional mode, emitting a pulsed biphasic, symmetrical rectangular wave with a frequency of 100 Hz and a pulse duration of 100 µs. The intensity was set according to the participant's tolerance then gradually increased and limited by the perception of strong but comfortable tingling. Patients were placed in a supine position with hips and knees slightly flexed. The electrical stimulation was conducted after physical exercises. It was administered for 30 min. A non-portable clinical stimulator TENS device (Multitronic MT-6, EiE, Otwock, Poland) was used.

Functional outcome measures

The functional assessment was performed 4 times: at baseline (I) and after each round of physiotherapy (II, III, IV). It was conducted using patient-reported outcome measures (PROMs) and assessor-observed PBTs.

Hip dysfunction and Osteoarthritis Outcome Score (HOOS) were used to assess hip-related function over the previous week of activity. HOOS is composed of 5 separately scored subscales and provides an estimate of each subject's symptoms, pain, activities of daily living limitations (ADL), sport and recreation function (SR), and quality of life assessment (QOL). Responses to questions are given using a Likert scale scored from 0 to 4. A percentage score ranging from 0 to 100 is calculated for each subscale, where 100 indicates no disability and 0 indicates severe disability [25].

Complementary to the self-reported measure, the OARSI recommended set of PBTs was used. The tests are assessed by counting, speed, and time measure [26].

The 30-second Chair Stand Test (30secCST) is designed to measure sit-to-stand activity. It measures the maximum number of chair stand repetitions (reps) possible in a 30 second period. From a sitting position, the patient stands up until the hips and knees reach full extension, then they sit back down completely so that that the buttocks fully touch the seat. Each cycle is counted as one chair stand. A 43-cm-high chair without armrests was used in the study.

The 40-metre Fast-Paced Walk Test (40mFPWT) is a test of performance based on the activity of short-distance walking. Participants are asked to walk as quickly as possible, without running, along a 10-m walkway and then turn around a cone and return. The sequence is repeated for a total distance of 40 m. Walking speed is measured in metres/second (m/s).

The Stair Climb Test (SCT) measures the time a participant needs to ascend and descend a flight of steps as quickly as possible. The number of stairs depends on individual environmental situations. The time needed is recorded in seconds. The stair in the testing area had 10 steps with a step height of 19 cm.

Performance-based tests were assessed by one physiotherapist with 5 years of experience.

Statistical analysis

Prior to analysis, data were cross checked for missing values and outliers. For missing items, the mean substitution approach was implemented (3 data missing completely at random were replaced by the average of all patients' scores at the given time point). Descriptive statistics were used to define the baseline characteristics of the sample. The discrete variables were reported as median and interquartile range (IQR), while categorical variables were described by patient counts and percentages (%). The Shapiro-Wilk normality test was used to verify the distribution of the data. The Mann-Whitney *U* test (*Z*) was used to compare differences between the groups. Differences between the functional outcome in 4 consecutive time points were analysed using Friedman repeated measures analysis of variance by ranks (χ^2) followed by a mean-ranks post-hoc test as required. The effect size was calculated using Kendall's coefficient of concordance. Correlations between functional parameters were assessed by using Spearman's rank correlation coefficient (*r*). A statistical significance level of 0.05 was regarded for the tests. The statistical analysis was conducted using Statistica PL version 13.3 (TIBCO Software Inc., Palo Alto, CA, USA). Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) was used to create charts.

Results

The baseline characteristics of the study group are summarized in Table 1. There were no differences observed in patients' baseline functional status due to age, sex, occupation, K-L, BMI, or SHOMRI.

The evaluation of the entire studied population revealed a trend of improvement in most of the examined aspects of functional assessment (Figures 2, 3). However, when assessed by group according to the presence or absence of structural progression, the results of both patient-reported and assessor-observed assessments showed important differences. Based on this division, there was a statistically significant improvement observed in terms of a subjective functional assessment (HOOS) among progressors. The scores improved in all domains except symptoms. In the group of non-progressors no changes were found in the patient-reported outcomes. In the area of objective functional assessment (PBTs), statistically significant improvement was observed in the non-progressors, while the progressors showed no changes in PBT outcomes (Table 2).

There was either a substantial or a definite but small relationship detected between HOOS and 2 of the PBTs (40mFPWT and SCT) at the first 3 consecutive time points: a positive correlation between HOOS and 40mFPWT and negative correlation between HOOS and SCT. The outcomes of the correlation analysis of 30secCST and HOOS showed inconsistency at successive time points and within individual HOOS domains (Table 3).

Table 1. Baseline demographics (*n* = 37)

Parameter	Value
Age [years] median (IQR))	58.00 (12.00)
BMI [kg/m^2] median (IQR)	25.48 (4.52)
Sex, *n* (%):	
Female	21 (56.8)
Male	16 (43.2)
Occupational activity, *n* (%):	
Sedentary	23 (62.2)
Active	14 (37.8)
Symptomatic joint, *n* (%):	
Left	18 (48.65)
Right	19 (51.35)
NRS, median (IQR):	
Symptomatic joint	4.00 (4.00)
Asymptomatic joint	1.00 (3.00)
KL grade, *n* (%):	
Symptomatic joint	1 = 5 (13.51%) 2 = 15 (40.54%) 3 = 14 (37.84%) 4 = 3 (8.11%)
Asymptomatic joint	1 = 7 (18.92%) 2 = 26 (70.27%) 3 = 4 (10.81%) 4 = 0 (0.00%)
SHOMRI, median (IQR):	
Symptomatic joint	10 (16)
Asymptomatic joint	6 (6)

BMI – body mass index, NRS – numerical rating scale, KL – Kellgren--Lawrence grading system, SHOMRI – scoring hip osteoarthritis with MRI. Variables are expressed as median, interquartile range (IQR), patient counts, and percentages (%).

Discussion

The purpose of the study was to evaluate changes of hip-related function in the course of physiotherapeutic treatment, and to examine the relationship between the evaluation methods used. Overall observation consistently pointed to an increase in function measures in the studied population; however, when assessed by the presence of structural progress, discrepancies between patient-reported and assessor-observed outcomes were exposed. The outcomes achieved in PROMs were not implicitly confirmed in the assessor-observed PBTs, which in theory are meant to reflect the actual functional status of the patients.

The significant rise in HOOS score shown over 12-month period in the group of progressors suggests that, despite the evolution of the disease, physiotherapy could have been a factor in reducing the severity of perceived pain and hence may have improved the sense of participation (ADL) and QOL. Our finding appears to be consistent with the observation of Holm et al., who found that rehabilitative management has its positive reflection in self-reported functional status in a large sample of patients with HOA in up to 24 months of follow-up [27]. We believe that actual structural progression may have been the factor, in our study, preventing objective functional improvement, which manifests in the outcome of specific PBTs. It has been repeatedly reported that increased severity of morphological signs in subjects with HOA is associated with an increased load on the joint resulting in abnormal kinetics during walking or stair ambulation [28–32].

Statistically significant improvement in physical performance was identified only in the patients characterized by lack of structural progression. We hypothesize that due to their physically inactive lifestyle, starting physiotherapy may have resulted in a relatively greater change in daily physical activity undertaken in comparison to regularly active progressors. It could therefore potentially have contrib-

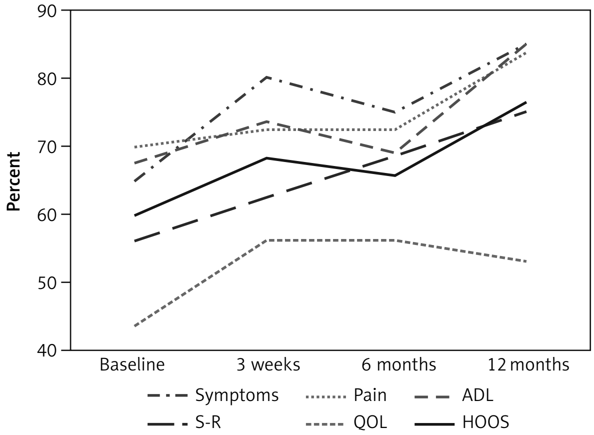

Figure 2. The trend of functional changes in the assessment with the use of patient-reported outcome measure

HOOS – Hip Dysfunction and Osteoarthritis Outcome Score, ADL – activities of daily living, SR – sport and recreation, QOL – quality of life. Values are expressed as median score for each time point.

uted to improvement in functional capabilities, allowing the participants to achieve physical tasks more easily. Burges *et al.*, who used the same set of PBTs in their study on muscle strength and endurance, linked decreased physical performance with deconditioning in patients with hip OA, which may advocate our supposition [33]. The much less noticeable improvement in 40mFPWT when compared to SCT may be related to the fact that stair ambulation is a more challenging activity. During level walking, hip muscle strength in people with HOA may be sufficient to keep the joint stable, but during stair ambulation a greater demand is placed on the lower extremity joints and muscles responsible for stabilizing the legs during the stance phase [31].

There are some difficulties in translating statistically significant improvement into clinical relevance in this study. Minimal clinically important differences (MCID) reported in the literature for the outcome measures used in the study vary greatly depending on the method of estimation used. Also, it should be pointed out that the context in which the outcome measure is given may influence the clinical importance in different patient populations. For HOOS, in a distribution-based method, a change of 9% was considered significant for each domain, but in the anchor-based approach the estimations differed, from 13% for QOL to as much as 36% for the pain sub-scale [34]. However, they were estimated for patients after total hip replacement only. Additionally, HOOS is recommended for use at a group level rather than individual level [35]. For performance-based measures in people with HOA the MCID of 2.0–2.6 repetitions was found to be associated with a major improvement in 30secCST and 0.2–0.3 m/sec in 40mFPWT [36]. No information on the MCID relevant to HOA was found for SCT [37].

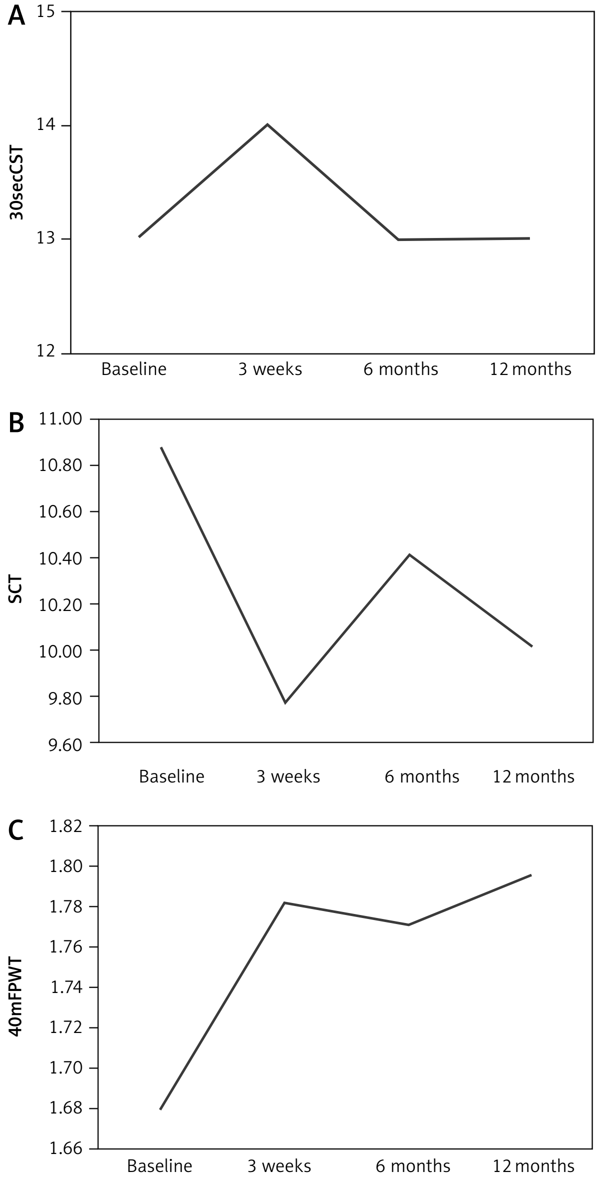

Figure 3. The trend of functional changes in the assessment with the use of performance-based tests. **A** – 30secCST, **B** – SCT, **C** – 40mFPWT

40mFPWT – 40-metre Fast-Paced Walk Test, 30secCST – 30-second Chair Stand Test, SCT – Stair Climb Test. Values are expressed as median score for each time point.

Having regard to Comprehensive International Classification of Functioning, Disability and Health Core Set for Osteoarthritis, the OARSI set of performance-based tests relates to the ability of walking (d450), climbing (d4551), changing body position (d410), and moving around (d455) [26, 38]. Theoretically, performance-based outcome measures are meant to reflect patients' actual functional capabilities. They assess what an individual can do rather than what they perceive they can do, which is determined by self-reported measures. The OARSI-recommended

Table 2. HOOS and performance-based test outcomes of progressors and non-progressors at baseline, 3 weeks, 6 months, and 12 months follow-up

Parameter	Group *P* = 7 *N* = 17	Baseline	3 weeks	6 months	12 months	χ^2	*P*-value	*W*	Post hoc
				Patient-reported:					
HOOS (%)	*P*	54.95 (49.06)	68.70 (24.57)	65.82 (31.81)	79.06 (24.41)	11.40	0.010	0.54	b, c
	N	67.37 (34.90)	75.47 (33.01)	60.69 (34.35)	72.72 (35.35)	5.82	0.120	0.11	–
Pain (%)	*P*	67.50 (52.50)	82.50 (27.50)	72.50 (40.00)	85.00 (17.50)	10.52	0.014	0.50	c
	N	70.00 (32.50)	75.00 (25.00)	72.50 (20.00)	77.50 (35.00)	3.81	0.283	0.07	–
Symptoms (%)	*P*	60.00 (35.00)	85.00 (30.00)	75.00 (20.00)	85.00 (20.00)	6.04	0.109	0.29	–
	N	75.00 (40.00)	80.00 (30.00)	75.00 (35.00)	85.00 (40.00)	5.98	0.112	0.11	–
ADL (%)	*P*	61.76 (60.29)	76.47 (19.12)	69.12 (42.65)	91.18 (22.06)	13.63	0.003	0.65	b, c
	N	69.12 (48.53)	72.06 (33.82)	67.65 (39.70)	82.35 (39.70)	7.24	0.064	0.14	–
SR (%)	*P*	43.75 (43.75)	62.50 (37.50)	68.75 (37.50)	81.25 (37.50)	12.62	0.005	0.60	b, c
	N	75.00 (37.50)	81.25 (43.75)	62.50 (56.25)	75.00 (56.25)	7.56	0.056	0.15	–
QOL (%)	*P*	37.50 (37.50)	56.25 (25.00)	50.00 (31.25)	56.25 (37.50)	14.39	0.002	0.68	b, c
	N	56.25 (31.25)	62.50 (31.25)	56.25 (37.50)	50.00 (37.50)	5.31	0.150	0.10	–
				Assessor-observed:					
40mFPWT [m/s]	*P*	1.23 (0.49)	1.83 (0.46)	1.75 (0.50)	1.79 (0.49)	6.26	0.100	0.30	–
	N	1.65 (0.16)	1.73 (0.23)	1.76 (0.29)	1.73 (0.35)	9.49	0.023	0.19	b
30secCST (reps)	*P*	13.00 (4.00)	14.00 (4.00)	13.00 (6.00)	15.00 (5.00)	4.60	0.204	0.22	–
	N	12.00 (2.00)	14.00 (3.00)	13.00 (2.00)	13.00 (4.00)	12.73	0.005	0.25	a, c
SCT [s]	*P*	10.17 (4.42)	10.54 (3.32)	11.01 (3.53)	9.70 (1.58)	5.57	0.134	0.26	–
	N	11.50 (1.99)	10.60 (1.39)	10.41 (1.65)	10.05 (2.12)	17.73	< 0.001	0.35	a, b, c

HOOS – Hip Dysfunction and Osteoarthritis Outcome Score, ADL – activities of daily living, SR – sport and recreation, QOL – quality of life, 40mFPWT – 40-metre Fast-Paced Walk Test, 30secCST – 30-second Chair Stand test, SCT – Stair Climb Test, P – progressors, N – non-progressors, χ^2 – Friedman's test statistic, W – Kendall's coefficient of concordance, Post-hoc comparisons – a – baseline vs. 3 weeks significance, b – baseline vs. 6 months significance, c – baseline vs. 12 months significance. Values are expressed as median (inter-quartile range). Bold font highlights significant results.

set was found to be reliable and appropriate for measuring changes in physical function performance, as reported by Dobson *et al.* [26, 39]. However, Tolk *et al.* pointed out that these tests may not target the exact same domain of physical function as PROMs; thus, changes assessed with HOOS may not affect the quantitative result of PBTs. Moreover, the authors suggested that impairment of the tested ADL is not fully captured by the performance. For example, standing up and sitting down in rapid sequence is not a model for stand-to-sit movement in daily life. Additionally, timing or counting repetitions does not capture the quality of performance, which is associated with perceived physical function [40].

Tolk *et al.* found no correlation between performance-based measures and HOOS-Physical Function Shortform (HOOS-PS) [40]. However, with the use of a slightly different set of physical performance tests, Scott *et al.* similarly showed no correlation of self-selected walking speed (SSWS), timed stair ascent (TSA), sit-to-stand 5 times (STS5), and 4-square step test (FSST) with the HOOS pain subscale and HOOS-PS in the group of participants with hip dysplasia [41]. On the other hand, Sheean *et al.*, in their study of femoroacetabular impingement patients using exactly the same physical performance tests, showed correlation of HOOS with TSA, STS5, and FSST [42]. In the present study the relationship between assessor-observed tests and PROMs in the total studied population was consequently demonstrated only for 40mFPWT and SCT at the baseline, and 3-week and 6-month follow-up. The outcomes for 30secCST were not consistent at consecutive time points.

There are limitations in this study that should be stressed. The primary one is the lack of a control group, which undoubtedly affects the process of drawing conclusions. However, under the conditions in which the study was conducted it was not

Table 3. Spearman's correlation analysis among symptomatic hip HOOS and performance-based tests at consecutive time points

Parameter	Time point	*N*	HOOS	Pain	Symptoms	ADL	SR	QOL
40mFPWT	I	37	0.43 (0.007)	0.43 (0.008)	0.34 (0.040)	0.49 (0.002)	0.53 (< 0.001)	0.34 (0.041)
	II	35	0.49 (0.003)	0.56 (< 0.001)	0.41 (0.015)	0.50 (0.002)	0.47 (0.004)	0.34 (0.044)
	III	31	0.51 (0.004)	0.46 (0.009)	0.50 (0.004)	0.48 (0.007)	0.49 (0.005)	0.46 (0.009)
	IV	26	0.31 (0.126)	0.34 (0.091)	0.36 (0.077)	0.27 (0.193)	0.30 (0.149)	0.32 (0.116)
30secCST	I	37	0.31 (0.065)	0.31 (0.061)	0.29 (0.083)	0.39 (0.017)	0.36 (0.030)	0.21 (0.210)
	II	35	0.30 (0.082)	0.32 (0.064)	0.24 (0.172)	0.33 (0.055)	0.31 (0.064)	0.26 (0.136)
	III	31	0.39 (0.028)	0.40 (0.025)	0.29 (0.117)	0.35 (0.052)	0.46 (0.009)	0.34 (0.062)
	IV	26	0.39 (0.052)	0.33 (0.105)	0.41 (0.038)	0.29 (0.155)	0.43 (0.034)	0.35 (0.083)
SCT	I	37	–0.50 (0.002)	–0.53 (< 0.001)	–0.42 (0.010)	–0.59 (< 0.001)	–0.53 (< 0.001)	–0.38 (0.018)
	II	35	–0.51 (0.002)	–0.59 (< 0.001)	–0.39 (0.020)	–0.53 (< 0.001)	–0.43 (0.009)	–0.47 (0.005)
	III	31	–0.58 (0.001)	–0.54 (0.002)	–0.45 (0.011)	–0.54 (0.001)	–0.58 (0.001)	–0.58 (0.001)
	IV	26	–0.40 (0.048)	–0.37 (0.068)	–0.36 (0.080)	–0.30 (0.149)	–0.26 (0.209)	–0.48 (0.015)

40mFPWT – 40-metre Fast-paced Walk Test, 30secCST – 30-second Chair Stand Test, SCT – Stair Climb Test, HOOS – Hip Dysfunction and Osteoarthritis Outcome Score, ADL – activities of daily living, SR – sport and recreation, QOL – quality of life, I – baseline, II – 3 weeks, III – 6 months, IV – 12 months. Values are expressed as Spearman's correlation rank coefficient r (p). Bold font highlights significant results.

ethically acceptable to create a symptomatic control group that would be positively diagnosed but would not receive treatment for a 12-month period deliberately. It should also be pointed out that the relatively small sample size may have contributed to the results obtained. Another factor that may have influenced the results is that the level of adherence was not assessed for the home-based maintenance program. The patients' activity during those 5-month intervals may have varied greatly, and we have no reliable data on this variable. Additionally, that longer follow-up could have allowed for assessment of the effect of continued structural progression on the need for, and timing of, hip arthroplasty in the studied population of rehabilitated patients.

Conclusions

The overall effect of rehabilitation on hip function in the studied population was positive, which is consistent with the generally accepted view. The most significant results of the study relate to the statistical differences observed over time regarding functional improvement between progressors and non-progressors in the aspect of the form of assessment. It is worth considering that progressors and non-progressors may be able to achieve different outcomes and thus require different and more personalized physiotherapeutic approaches. The relationship between PBTs scores and scores on the HOOS comparative instrument was also noticed, but it was not unequivocal. Further assessment may be required to elucidate dependencies in detail.

Conflict of interest

The authors declare no conflict of interest.

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Address for correspondence

Agnieszka Lewińska
Chair of Clinical Physiotherapy
Faculty of Rehabilitation
Józef Piłsudski University of Physical Education
Warsaw, Poland
E-mail: agnieszka.lewinska@awf.edu.pl