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Health-Related Quality-of-Life and Functional Outcomes in Short-Stem Versus Standard-Stem Total Hip Arthroplasty: An 18-Month Follow-Up Cohort Study

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1 Brandon Michael Henry
ABCDEF 2 Waldemar Wrażeń
ABCDEF 1 Leif Hynnekleiv
ABCDEF 1,3 Michał Kłosiński
ABCDEF 1 Przemysław A. Pękala
ABCDEF 4 Ewa Kucharska
ABCDEF 2,5 Edward B. Golec
ABCDEF 1,2 Krzysztof A. Tomaszewski
ABDE 6,7 Maria Pąchalska

1 Department of Anatomy, Jagiellonian University Medical College, Cracow, Poland
2 Department of Orthopaedics and Trauma Surgery, 5th Military Clinical Hospital in Cracow, Cracow, Poland
3 Department of Neuroorthopaedics, Rydygier Specialist Hospital, Cracow, Poland
4 Department of Gerontology, Geriatrics and Social Work, Ignatianum Academy, Cracow, Poland
5 Department of Clinical Rehabilitation, Faculty of Motor Rehabilitation, Bronisław Czech University School of Physical Education, Cracow, Poland
6 Department of Neuropsychology, Andrzej Frycz-Modrzewski Cracow University, Cracow, Poland
7 Center for Cognition and Communication, New York, NY, U.S.A.

Corresponding Author: Krzysztof A. Tomaszewski, e-mail: krtomaszewski@gmail.com
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Background: Osteoarthritis (OA) progressively produces symptoms and disability that may significantly reduce health-related quality of life (HRQoL). Total hip arthroplasty (THA) is an important treatment for symptomatic OA. An alternative to standard-stem THA for younger patients is short-stem THA. The aim of this study was to investigate potential HRQoL and functional outcome differences between these patient groups to provide additional data that will be clinically useful in the decision making between the types of prosthesis.

Material/Methods: In an 18-month follow-up longitudinal cohort study, we conducted Harris Hip Score (HHS) evaluations and SF-36 questionnaires in a study group and a control group undergoing short-stem and standard-stem THA preoperatively and during follow-up at 1, 3, 6, 12, and 18 months. Effect size was calculated to estimate the size of changes in scores during follow-up between chosen time intervals.

Results: A total of 168 patients were included in the study. The total HHS score was significantly increased postoperatively from 46.9 to 87.0 in the standard-stem group, and from 42.7 to 85.1 in the short-stem group. All SF-36 scores improved after THA in both groups. No HRQoL or functional differences were found in the use of either surgical option in the HHS or SF-36 score results (all $p>0.05$).

Conclusions: As there were no differences in HRQoL in the two groups, we strongly recommend considering short-stem THA, especially in younger patients, due to the benefit of future revision options and a minimally invasive approach.

MeSH Keywords: **Arthroplasty, Replacement, Hip • Hip Prosthesis • Orthopedics • Osteoarthritis • Quality of Life**

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Background

The non-surgical treatment options for osteoarthritis (OA) are largely limited to palliative care [1]. There also exist some clinically effective programs for patients with OA combining peer- and healthcare professional-delivered information, and individually adapted exercise, that seem useful and acceptable to patients [2]. However, surgical methods are still considered the best therapeutic option. One of the most commonly applied surgical procedures among people with OA of the hip is arthroplasty [3]. More that one million arthroplasties are performed each year globally [4]. It has been shown that mid-term post-operative health-related quality of life (HRQoL) is significantly increased in total hip arthroplasty (THA) patients compared to presurgical assessment [5]. In recent years, short-stem arthroplasty, an alternative method to conventional THA, has been introduced. Short-stem arthroplasty allows for minimally invasive surgical procedures and enables future revisions of the proximal parts of the femur. This procedure was also designed to improve the biomechanical properties of the hip after arthroplasty [6].

About 2 million individuals in Poland are diagnosed with OA [7]. The prevalence of symptomatic hip OA is about 3% of the population [8]. A large portion of them will eventually require hip arthroplasty. There are many risk factors associated with development of osteoarthritis that are divided into two groups: (1) general risk factors, such as age, genes, obesity, diet, and gender; and (2) joint-specific risk factors, such as trauma and overuse [9]. The most common symptoms of OA are joint pain, stiffness, and swelling [10].

Apart from assessing purely physical outcomes of OA treatment, one should also focus on determining the HRQoL due to the subjective nature of OA's symptoms [11]. Osteoarthritis progressively produces symptoms and disability that may significantly reduce patients' HRQoL [12,13]. Health-related quality of life assessment quantitatively and accurately measures a patient's current physical, emotional, psychological, social, and functional status. Essentially, it measures how a patient's life is affected by the disease [14].

There are two types of HRQoL questionnaires: generic and disease specific. The OA-specific HRQoL questionnaires include the Western Ontario and McMaster University Osteoarthritis Index (WOMAC) [15], Harris Hip Score (HHS) [16–18], McMaster University Osteoarthritis Index (MACTAR) [19], Osteoarthritis Knee and Hip Quality of Life questionnaire (OAKHQOL) [20], Merle d'Aubigne-Postel (MAP) [21], and Functional Comorbidity Index (FCI) [22]. There are also general questionnaires to assess HRQoL that have been applied in patients with OA and various other diseases, such as the Short Form 36 (SF-36) [23,24] or the EQ-5D used by the Swedish Hip Arthroplasty register [25]. Comparative data on HRQoL after short-stem hip arthroplasty and standard-stem hip arthroplasty are scarce and require further study. The goal of this study was to compare the HRQoL, as well as functional outcomes of patients, after short- and standard-stem hip arthroplasty. Filling this gap of knowledge is required to better individualize therapeutic options for patients needing hip arthroplasty in order to maximize post-surgical HRQoL.

Material and Methods

Study design

A total of 168 patients who were scheduled to undergo elective hip arthroplasty between January 2008 and December 2014 at two Polish hospitals, the 5th Military Clinical Hospital, Cracow, and the Rydygier Specialistic Hospital, Cracow, were recruited for this prospective HRQoL study. The study sample included 84 patients who underwent short-stem hip arthroplasty and 84 age- and gender-matched subjects who underwent standard-stem hip arthroplasty and functioned as the control group. Both the short-stem (Proxima) and standard-stem (Corail) hip prostheses were manufactured by Depuy (Johnson & Johnson, New Jersey, USA). Assessments were performed preoperatively and at 1, 3, 6, 12, and 18 months post-surgery. The inclusion criteria were a minimum patient age of 18 years, requirement of either standard- or short-stem hip arthroplasty, and giving informed consent to participate in the study. Exclusion criteria were the inability to understand or complete the questionnaires and existing significant morbidity that would likely heavily influence the HRQoL, such as cancer, congestive heart failure, and severe lung, renal, or liver disease.

All patients were thoroughly informed of and educated on the details of the study prior to their inclusion. Data were collected regarding the age, gender, marital status, education level, previous arthroplasty, comorbidities, principal diagnosis, surgery time, days in hospital, and participation in outpatient physiotherapy for each patient enrolled in the study.

Questionnaires

Two separate questionnaires were utilized: the Polish version of the SF-36 Health Survey [23] and the HHS [16–18].

The SF-36 was filled out by the patient (with assistance from the surgeon when needed) and contained a total of 36 question-and-response items. The SF-36 is organized into eight multi-item scales: physical functioning (PF), role limitations due to physical health problems (RP), bodily pain (BP), general health perceptions (GH), vitality (VT), social functioning (SF), role limitations due to emotional problems (RE), and general mental health (MH). The results are converted to a 0–100 scale score, in which a higher score indicates higher levels of functioning or a higher feeling of well-being.

The HHS is a three-section, 13-question qualitative and quantitative assessment of physical and clinical orthopedic characteristics like pain, limp, and degrees of motion. The interviews and examinations necessary for the HHS were always performed by a qualified orthopedic surgeon.

In addition to the SF-36 and HHS, at 12 months, the patients in the study group were asked two additional questions for a short qualitative survey: (1) "Do you feel that in terms of your physical functioning, you have returned to full, unrestricted activity?" and (2) "Do you feel that in terms of your mental functioning, you have returned to the same level as when you were healthy?" The available answer choices were "yes", "no," or "I do not know."

Statistical analysis

Descriptive statistics (mean, standard deviation, percentage distribution) were used when appropriate to analyze demographic data. The Shapiro-Wilk test or the Kolmogorov-Smirnov test (as appropriate) was used to assess the distribution of the results.

Assessment of the differences in scores at different time points of the study (baseline *vs.* 1, 3, 6, 12, and 18 months) was performed using the Mann-Whitney U test (due to the non-normal distribution of data). The same analytical method was used to compare mean HHS scores between subgroups of patients (male *vs.* female, high-school *vs.* university education, deciding *vs.* not deciding to get outpatient physiotherapy) in the study. All correlations were calculated using Pearson's product-moment correlation.

Effect size (ES) was calculated as the difference between the mean scores for two time intervals divided by the standard deviation of the score for the previous (or former) time interval [26]. This method allows for direct comparisons of the amount of change between two instruments by standardizing the change measured by an instrument. An ES of 1.0 is equal to change in the sample of 1 standard deviation. An ES of 0.2 was considered as a small change, 0.5 as a medium change, and 0.8 as a large change [26].

The acceptability of the questionnaires was assessed by the response rate, the percentage of missing data, and the assistance and time needed to complete the questionnaires [27–29]. Statistical analysis was conducted using Statistica 10.0 PL by StatSoft Poland and Medcalc 13.0. The significance level for all statistical tests was set at $p<0.05$.

Ethics

The study was conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments The research protocol was approved by the Bioethical Committee of the Regional Physicians Chamber in Cracow. Written, informed consent was obtained from each and every patient, both in the study group and in the control group, before enrollment in the study.

Results

A total of 89 patients who were scheduled to undergo short-stem arthroplasty were approached to participate in the study group, of which 84 (94.4%) gave their final consent for participation. A total of 91 patients who were scheduled to undergo standard-stem arthroplasty were recruited to participate in the control group, of which 84 (92.3%) gave their final consent for participation. Lack of consent to participate in the study was due to unwillingness of the patients. The mean age in the study group was 51.3±4.7 years, while the mean age of patients in the control group was 52.9±8.2 years ($p=0.19$). The baseline characteristics of the study participants are presented in Table 1.

Patients responded to 96.5% of items in the questionnaires. Special assistance in completing forms was provided to 50 patients: 32 in the study group and 18 in the control group. In most cases when help was needed, it was due to vision-related problems. The average time required to complete the questionnaire was 13.7±5.1 min for patients who completed the questionnaire alone and 23.8±4.7 min for patients who needed assistance in completing the form.

Harris Hip Score

The total HHS score was significantly increased postoperatively from 46.9 to 87.0 in the control group, and from 42.7 to 85.1 in the study group (Table 2). The HHS score peaked at the last assessment (18 months), with values of 91.3 and 89.7 for the control and study groups, respectively. The differences between the control and study groups decreased during follow-up, from 2.9 to 1.6, measured 1 month and 18 months after surgery. There were no statistically significant differences between patients in the short-stem group versus the standard-stem group in any HHS preoperative scores, nor during the follow-up period (all $p>0.05$).

In both the control and study groups, pain function improved significantly after hip arthroplasty: from 23.7 to 36.9 in the control group and from 20.1 to 35.2 in the study group. This score was continuously increasing during the follow-up period,

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Table 1. Participants' baseline data.

	Short-stem (n=84)	Normal-stem (n=84)	p-value for comparison of both groups
Age (SD)	51.3 (4.7)	52.9 (8.2)	0.12
Gender – female	39 (46.4%)	43 (51.2%)	0.64
Marital status			
Married	71 (84.5%)	77 (91.7%)	0.23
Divorced	9 (10.7%)	5 (6.0%)	0.41
Widowed	4 (4.8%)	2 (2.4%)	0.67
Education			
Primary school	3 (3.6%)	1 (1.2%)	0.61
High School or equivalent	37 (44.0%)	42 (50.0%)	0.52
University	44 (52.4%)	41 (48.8%)	0.76
Previous arthroplasty – yes	5 (6.0%)	11 (13.1%)	0.19
Comorbidities (average number ±SD)	0.6 (0.5)	0.7 (0.6)	0.24
Principal diagnosis – osteoarthritis	58 (69.0%)	70 (83.3%)	0.05
Surgery time (mean SD)	82.7 (14.1)	71.4 (7.6)	<0.0001
Average length of hospital stay in days (mean SD)	8.3 (1.4)	8.9 (2.0)	0.03
Number of patients deciding for outpatient physiotherapy	40 (47.6%)	47 (56.0%)	0.35

while score differences between the groups were continuously decreasing over time.

Significant improvement was also noted in postoperative physical functioning. This score increased from 19.3 to 26.4 in the control group and from 17.9 to 28.0 in the study group. In the consecutive evaluations during follow-up, increasing values for this parameter were noted, with the highest scores observed at 18 months postoperatively (40.2 in the control group and 39.7 in the study group).

SF-36

All SF-36 scores improved after hip arthroplasty in both the control group and the study group. A statistically significant difference between scores of the two groups was found only in the preoperative bodily pain score (p=0.001). No statistically significant differences in SF-36 scores between the control and study groups during the follow-up period were found (all p>0.05).

The largest difference between preoperative scores was noted in the RP parameter, which describes role limitations due to physical health problems. It increased from 9.0 to 32.2 and from 6.9 to 34.7 in the control and study groups, respectively. This score was continuously increasing during the entire follow-up period and reached the highest level in the final assessment at 18 months, with values of 71.9 for the control group and 73.7 for the study group. There was a clear tendency of increasing evaluation scores 1 month after surgery, as well as a continuous increase in all measured parameters at consecutive time intervals after.

Effect size

Effect size was calculated to estimate the size of changes in scores during follow-up between chosen time intervals (preoperative – 1 month, preoperative – 3 months, 1–3 months, 3–6 months, 6–12 months, and 12–18 months).

The results of the ES calculations showed that the differences in the total HHS scores were highest at the start of follow-up. Noteworthy was the improvement in the total HHS score in both the control and study groups. The total HHS score was higher after 1 month than after 3 months postoperatively. The ES calculations showed positive changes in the HHS score in

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Table 2. The HHS and SF-36 score changes over time.

Scale/domain	Pre-oparative Ss n=84	Pre-oparative St n=84	1 month Ss 84	1 month St 84	3 months Ss 84	3 months St 82	6 months Ss 81	6 months St 81	12 months Ss 81	12 months St 80	18 months Ss 77	18 months St 79
HHS												
Pain function	20.1 (7.3)	23.7 (11.2)	35.2 (7.2)	36.9 (9.1)	40.5 (6.6)	41.0 (7.1)	42.4 (7.0)	42.9 (5.3)	43.4 (8.2)	42.9 (5.9)	43.1 (7.7)	43.8 (6.2)
Physical function	17.9 (14.5)	19.3 (9.7)	28.0 (4.1)	26.4 (8.5)	30.2 (9.1)	31.6 (7.2)	35.8 (5.1)	34.4 (8.3)	39.0 (9.9)	39.7 (7.0)	39.7 (5.4)	40.2 (7.3)
Total	42.7 (19.3)	46.9 (12.0)	85.1 (8.4)	87.0 (4.1)	81.8 (9.5)	83.6 (8.8)	84.7 (9.2)	83.9 (7.4)	86.1 (6.8)	85.0 (8.5)	89.7 (4.1)	91.3 (8.3)
SF-36												
PF	29.1 (30.7)	32.0 (21.9)	48.3 (25.1)	50.3 (15.4)	55.7 (20.6)	54.1 (17.2)	61.1 (18.0)	64.5 (19.3)	74.4 (13.2)	77.1 (17.9)	78.1 (15.2)	80.9 (11.6)
RP	6.9 (33.5)	9.0 (29.7)	34.7 (40.3)	32.2 (37.4)	41.1 (34.8)	42.0 (31.9)	49.5 (33.1)	51.7 (29.6)	63.8 (38.2)	62.3 (36.1)	73.7 (32.4)	71.9 (26.3)
BP	40.1 (12.7)	45.8 (9.2)*	45.3 (16.4)	47.1 (10.1)	50.4 (12.8)	51.2 (8.9)	53.7 (9.3)	54.5 (7.9)	55.0 (7.1)	54.7 (7.9)	55.3 (7.4)	54.6 (8.2)
GH	49.8 (13.0)	48.4 (12.3)	52.3 (16.6)	51.9 (15.3)	56.9 (15.7)	56.4 (13.8)	61.5 (11.7)	62.0 (14.8)	64.7 (14.2)	65.2 (14.9)	68.1 (13.9)	68.7 (14.5)
VT	45.7 (18.1)	46.2 (17.8)	53.9 (15.3)	53.1 (14.0)	56.0 (12.2)	57.3 (14.1)	58.7 (13.0)	58.0 (12.5)	61.4 (14.5)	62.3 (13.9)	61.1 (11.4)	61.8 (11.5)
SF	40.6 (19.9)	44.2 (18.4)	48.1 (25.4)	49.7 (28.0)	63.8 (19.2)	65.1 (22.3)	72.0 (16.8)	73.5 (20.9)	80.3 (15.0)	79.9 (17.2)	85.7 (14.6)	85.9 (15.3)
RE	36.9 (47.4)	39.0 (38.2)	61.2 (30.5)	63.4 (29.1)	67.7 (24.9)	66.9 (23.0)	74.2 (21.7)	73.5 (19.8)	75.7 (22.6)	76.6 (21.5)	76.2 (23.0)	76.9 (22.1)
MH	53.7 (12.1)	52.9 (13.0)	61.8 (15.3)	62.2 (14.1)	64.0 (12.7)	63.7 (14.5)	66.1 (11.3)	65.6 (13.0)	68.3 (12.6)	67.9 (11.1)	67.7 (12.9)	67.5 (12.0)

Data presented as mean values ±(SD). The p-values are comparing ss and st groups and the same time point; * $p<0.05$.
HHS – Harris Hip Score; SF-36 – short form 36; Ss – short-stem; St – standard-stem; SD – standard deviation; n – number;
PF – physical functioning; RP – role limitations due to physical health problems; BP – bodily pain; GH – general health perceptions;
VT – vitality; SF – social functioning; RE – role limitations due to emotional problems; MH – general mental health.

all categories in the subsequent intervals, except for the total HHS score in the 1–3 months interval in both groups. These changes were significantly smaller compared to the improvements in the early time intervals.

Similar tendencies were observed in the SF-36 score changes as revealed by ES calculations. The greatest improvement occurred at the beginning of follow-up, while the differences were significantly lower and declining in later evaluations.

Twelve months after surgery, there were negligible differences in HRQoL and functionality between the study group and control group (Table 2). This was also observed in the ES, as presented in Table 3.

Both the HHS and SF-36 pain assessments found no statistically significant gender differences ($p>0.05$) for either treatment group at any point in time. Other differences, however, were found between gender. The SF, RE, and MH domains of the SF-36 were lower in women than in men ($p<0.01$) at 3, 6, and 12 months but not at 18 months ($p>0.05$). Females also had a lower SF-36 GH score at 3 and 6 months ($p<0.05$).

There were observable differences in recovery between patients who decided to participate in outpatient physiotherapy versus those who did not. At 3 and 6 months, those who underwent physiotherapy had higher HHS Physical Function for both patient groups ($p<0.01$). Furthermore, those who underwent physiotherapy had higher PF, RP, MH, and VT scores at three months. They returned to normal levels at 6 months and stayed there (except for RP, which normalized at 12 months).

Education level did not influence the long-term outcomes. In the short-term, the HHS Pain Function at 1 ($p<0.001$), 3 ($p<0.001$),

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Table 3. Effect size of change in scores for each dimension of HRQoL for THA patients at different time intervals.

Interval	Preoperative to 1 months				Preoperative to 3 months				1 to 3 months			
Group	Ss		St		Ss		St		Ss		St	
	d	95% CI	d	95% CI	d	95%CI	d	95% CI	d	95% CI	d	95% CI
HHS												
Pain function	2.08	1.71 to 2.46	1.29	0.96 to 1.63	2.93	2.50 to 3.37	1.84	1.48 to 2.20	0.77	0.45 to 1.08	0.50	0.19 to 0.81
Physical function	0.95	0.63 to 1.27	0.78	0.47 to 1.09	1.02	0.70 to 1.34	1.44	1.10 to 1.78	0.31	0.01 to 0.62	0.66	0.35 to 0.97
Total	2.85	2.42 to 3.28	4.47	3.91 to 5.04	2.57	2.16 to 2.98	3.48	3.0 to 3.96	to 0.37	−0.6 to −0.06	to 0.50	−0.81 to −0.19
SF-36												
PF	0.68	0.37 to 1.0	0.97	0.65 to 1.29	1.02	0.70 to 1.34	1.12	0.79 to 1.45	0.32	0.02 to 0.63	0.23	−0.07 0.54
RP	0.75	0.44 to 1.06	0.69	0.38 to 1.0	1.04	0.72 to 1.37	1.07	0.75 to 1.40	0.17	−0.13 to 0.47	0.28	−0.02 to 0.59
BP	0.35	0.05 to 0.66	0.13	−0.17 to 0.44	0.81	0.49 to 1.12	0.60	0.29 to 0.91	0.35	0.04 to 0.65	0.43	0.12 to 0.74
GH	0.17	−0.14 to 0.47	0.25	−0.05 to 0.56	0.49	0.19 to 0.80	0.61	0.30 to 0.92	0.28	−0.02 to 0.59	0.31	0.0 to 0.62
VT	0.49	0.18 to 0.80	0.43	0.13 to 0.74	0.67	0.36 to 0.98	0.69	0.38 to 1.0	0.15	−0.15 to 0.46	0.30	−0.01 to 0.61
SF	0.33	0.02 to 0.63	0.23	−0.07 to 0.54	1.19	0.86 to 1.52	1.02	0.70 to 1.35	0.70	0.39 to 1.01	0.61	0.30 to 0.92
RE	0.61	0.30 to 0.92	0.72	0.41 to 1.03	0.81	0.50 to 1.13	0.88	0.56 to 1.20	0.23	−0.07 to 0.54	0.13	−0.17 to 0.44
MH	0.59	0.28 to 0.90	0.69	0.38 to 1.0	0.83	0.52 to 1.15	0.78	0.47 to 1.10	0.16	−0.15 to 0.46	0.10	−0.20 to 0.41
Interval	**3 to 6 months**				**6 to 12 months**				**12 to 18 months**			
Group	**Ss**		**St**		**Ss**		**St**		**Ss**		**St**	
	d	**95% CI**	**d**	**95% CI**	**d**	**95%CI**	**d**	**95% CI**	**d**	**95% CI**	**d**	**95% CI**
HHS												
Pain function	0.28	−0.03 to 0.59	0.30	−0.01 to 0.61	0.13	− 0.18 to 0.44	0.00	−0.31 to 0.31	−0.04	−0.35 to 0.27	0.15	−0.16 to 0.46
Physical function	0.76	0.44 to 1.07	0.36	0.05 to 0.67	0.41	0.10 to 0.72	0.69	0.37 to 1.01	0.09	−0.23 to 0.40	0.07	−0.24 to 0.38
Total	0.31	0.0 to 0.62	0.04	−0.27 to 0.34	0.17	−0.14 to 0.48	0.14	−0.17 to 0.45	0.64	0.32 to 0.96	0.75	0.43 to 1.07
SF-36												
PF	0.28	− 0.03 to 0.59	0.57	0.26 to 0.88	0.84	0.52 to 1.16	0.68	0.36 to 0.99	0.26	−0.05 to 0.57	0.25	−0.06 to 0.56
RP	0.25	−0.06 to 0.55	0.32	0.01 to 0.62	0.40	0.09 to 0.71	0.32	0.01 to 0.63	0.28	−0.04 to 0.59	0.30	−0.01 to 0.62
BP	0.29	−0.01 to 0.60	0.39	0.08 to 0.70	0.16	−0.15 to 0.47	0.03	−0.28 to 0.33	0.04	−0.27 to 0.35	−0.01	−0.32 to 0.30
GH	0.33	0.02 to 0.64	0.39	0.08 to 0.70	0.25	−0.06 to 0.56	0.22	−0.09 to 0.53	0.24	−0.07 to 0.56	0.24	−0.07 to 0.55
VT	0.21	−0.09 to 0.52	0.05	−0.26 to 0.36	0.20	−0.11 to 0.51	0.33	0.01 to 0.64	−0.02	−0.34 to 0.29	−0.04	−0.35 to 0.27
SF	0.45	0.15 to 0.76	0.39	0.08 to 0.70	0.52	0.21 to 0.83	0.33	0.02 to 0.65	0.36	0.05 to 0.68	0.37	0.06 to 0.68
RE	0.28	−0.03 to 0.59	0.31	−0.0 to 0.62	0.07	−0.24 to 0.38	0.15	−0.16 to 0.46	0.02	−0.29 to 0.33	0.01	−0.30 to 0.33
MH	0.17	−0.13 to 0.48	0.14	− 0.17 to 0.45	0.18	−0.13 to 0.49	0.19	−0.12 to 0.50	−0.05	−0.36 to 0.27	−0.03	−0.35 to 0.28

HRQoL – health-related quality-of-life; THA – total hip arthroplasty; HHS – Harris Hip Score; SF-36 – short form 36; Ss – short-stem; St – standard-stem; PF – physical functioning; RP – role limitations due to physical health problems; BP – bodily pain; GH – general health perceptions; VT – vitality; SF – social functioning; RE – role limitations due to emotional problems; MH – general mental health.

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6 ($p<0.01$), and 12 ($p<0.05$) months showed lower scores for patients with higher education. Similar results were found in the BP domain of the SF-36. There were no differences found relating to education in the RP or RE categories. Patients with a university-level education had a higher score on the social functioning results of the SF-36 at 3 months ($p<0.05$).

The length of stay in the hospital and the operating time did not correlate ($p>0.05$) with any of the HHS or SF-36 subscales, regardless of the type of arthroplasty performed.

A total of 77 patients after short-stem hip arthroplasty took part in the qualitative survey at the 12-month mark. In response to the question "Do you feel that in terms of your physical functioning, you have returned to full, unrestricted activity?" 90.1% said yes, while 9.9% said no. In response to the question "Do you feel that in terms of your mental functioning, you have returned to the same level as when you were healthy?" 84.4% said yes, 6.5% said no, and 9.1% said I don't know.

Discussion

There is a lack of studies investigating the differences between short- and standard-stem hip arthroplasty. This study was designed to find differences in HRQoL between these two patient groups during an 18-month follow-up. In general, when comparing 18-month HRQoL and functionality with baseline (the preoperative assessment), this study is in line with previously published work, demonstrating large patient benefits from hip arthroplasty [5,30].

Health-related quality of life is an excellent way of ensuring that treatment is indeed helpful for the patient, as traditional methods of assessment such as surgical success rates and prosthesis failure rates are of lower priority in patient-centered medical practice [30]. In orthopedics. HRQoL has become an important method of assessment of treatment outcomes [30]. With an aging population and increased life expectancy, the number of patients with OA is only expected to rise [31]. The results of our study add to the evidence base for surgical decision making in this growing group of patients.

This study found significant improvement in both patient groups in HRQoL after hip arthroplasty. The most rapid changes were observed in the first and second postoperative evaluations (1 and 3 months). There were no significant differences in HRQoL and functioning between short- and standard-stem groups during the follow-up period. In other words, short and standard stems provided essentially the same HRQoL results and functionality scores. As such, we suggest use of short stems in hip arthroplasty, especially in younger patients, due to the benefit of future revision opportunity.

All group and subgroup differences, when present, equalized around the 6-, 12-, or 18-month mark, suggesting that there is a period around 1–1.5 years after surgery is performed when patient HRQoL approaches an equilibrium, regardless of treatment method, sex, education, or any of the other subgroup categories.

The ESs of changes in HHS scores were lower than ESs of changes in the SF-36 scores. This is in line with results obtained by Shi et al. [30], who evaluated their patient group through a 5-year follow-up period. They discovered that the differences observed in the period from the 6th month to the 5th year are similar and much smaller compared to improvements in the first 6 months after surgery [30]. They also concluded that HHS and SF-36 scores should be weighted equally in HRQoL assessments of THA patients [30].

During the last decade, significant research effort has gone into exploring differences in pain perception, especially between the sexes. This is a complex topic, as the discussion envelops not only pain thresholds but also differences in psychological and emotional effects of acute and chronic pain. There is agreement that there are substantial differences in how males and females perceive pain [32]. Our study, as described in the results, did not find any differences in gender pain perception. This might be explained by the simplified method of pain assessment in the questionnaire, by the limited group size, or perhaps because the finding is true. If this is indeed a true finding, it suggests that THA as a major surgical operation is gender neutral when it comes to postoperative pain. This seems to be true also for the eventual decrease in pain compared to baseline, as the treatment effect takes place. Other gender-related findings that we discovered suggested that male recovery in the SF, ME, RH, and GH domains was slightly accelerated compared to that in females. Clinicians might want to keep these HRQoL gender differences in mind during follow-up evaluation of patients after THA.

Subgroup analysis results in the physiotherapy versus non-physiotherapy groups suggest that physiotherapy accelerates physical and psychological recovery in the first 3–6 months in both short- and standard-stem arthroplasty, but that these differences were not measurably changing the long-term HRQoL, as the score differences were transient and all evened out by the 12-month mark. This, however, does not imply that physiotherapy is unimportant, since a quicker recovery means patients can return to a normal level of activity earlier. An extensive literature review revealed that as in our study, physiotherapy in THA patients does not seem to have any long-term benefit [33].

Acknowledging that there are numerous ways to present HRQoL data and their changes [34,35], including newer and clinically easier to interpret methods like the Improvement Ratio [35], we decided to present our results using ES. This enabled us to compare our results to the ones obtained by Shi et al. [30], allowing for further generalization (e.g., inclusion in potential meta-analyses) and future cross-comparability of our data. Additionally, we modeled our data presentation approach after the one employed by Shi et al. [30] as our departments use, as a best practice standard, the same HRQoL assessment tools (HHS and SF-36) as did Shi et al. [30] in their study.

The main limitation of this study is the lack of long-term follow up. Our data are limited to an 18-month post-operative patient assessment. Prosthesis failures are known to occur no earlier than 2 years after surgery, which is detrimental to HRQoL [36]; however, that falls outside the time frame of our study. Fortunately, previously published studies on standard-stem HA have not shown significant changes in HRQoL after 18 months of follow-up. The findings of Shi et al. [30] in their 5-year follow-up study show that the changes in HRQoL and functionality scores after 12 months were minimal.

Participant dropout is an inevitable source of study limitation in longitudinal cohorts [36–38]; however, our dropout rate was minimal. A total of 12 patients were lost to follow-up by the end of the study. A typical limitation in this type of study is the lack of reliable data due to a too small study group. In our study, however, we found several statistically significant subgroup differences, indicating that our study size was appropriate.

To strengthen our study, we used two parallel assessment methods (HHS and SF-36) instead of just one to ensure a broader range of assessment, as well as overlapping themes to give the opportunity to compare results and trends. Multiple time intervals of measurement ensure a smaller influence of outliers and increase certainty that the results, and the differences between the results, are accurate. Trends in differences and amplitudes between all groups and subgroups were virtually the same or extremely similar for HHS and SF-36 scores. This gives us confidence in the validity of our results and shows that HRQoL and functional testing results are intimately related [36].

Conclusions

No differences in HRQoL and functionality were found between the short- and standard-stem THA groups, and the two groups demonstrated equivalent improvement in all measures compared to baseline at 18 months. Any differences that were found between any groups or subgroups in the early postoperative period were equalized before the end of the study period. As there were no significant differences in HRQoL outcomes after surgery between short- and standard-stem THA, we recommend that short-stem THA be strongly considered in young patients due to its minimally invasive approach and to allow for easier revision in the future.

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