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Original Article

Analysis of factors influencing patient satisfaction after total hip arthroplasty in a Japanese cohort: the significant effect of postoperative physical activity

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Abstract. [Purpose] To determine patient satisfaction after total hip arthroplasty in a Japanese cohort and to identify factors that significantly influence patient satisfaction. [Participants and Methods] This study included 285 patients who underwent primary total hip arthroplasty for osteoarthritis. Postoperative satisfaction, Oxford hip score, short form-12 mental component summary score, and University of California Los Angeles activity score were investigated. Muscle strength and daily step counts were determined using a hand-held dynamometer (μ-Tas F1) and activity monitor (ActivPAL) in 89 and 26 patients, respectively. Factors associated with postoperative satisfaction, Oxford hip score-activities of daily living, and University of California Los Angeles activity score were identified. The relationship between the Oxford hip score-activities of daily living and daily step counts was examined. [Results] Overall, 94.7% of the patients reported satisfaction with total hip arthroplasty. The Oxford hip score-activities of daily living and University of California Los Angeles activity score were significantly associated with patient satisfaction. Younger age and hip abductor strength were significantly associated with a higher Oxford hip score-activities of daily living and University of California Los Angeles activity score. The average daily step count was significantly correlated with the Oxford hip score-activities of daily living. [Conclusion] Self-reported physical activity levels significantly influenced patient satisfaction and were correlated with objective muscle strength and daily step count measurements. These findings can guide total hip arthroplasty patient counseling on the importance of muscle strength and activity levels.

Key words: Total hip arthroplasty, Patient's satisfaction, Activity monitor

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INTRODUCTION

Osteoarthritis of the hip is a frequent[1–3)] and disabling[3)] condition and its prevalence is on the rise. Currently, total hip arthroplasty (THA) is the most efficient treatment to relieve pain and reduce disability in patients with end-stage osteoarthritis[4, 5)]. With advancements in implants and surgical techniques, THA has enabled improvements in ambulation, recovery of

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the activities of daily living (ADL), and a return to society for many of the patients[6, 7].

Recently, the indications for THA have been expanded to include younger patients, and it is expected to improve their postsurgical activity levels, even including their return to sports[8–11]. On the other hand, patients who remain anxious about activity limitation and dislocation do not experience the subsequent improvement in quality of life (QOL)[12–17]. Previous studies from Western countries have reported that 7–15% of patients still feel dissatisfied postoperatively after THA[18, 19]. Older age, functional impairment, psychological distress, comorbidities, and lower socioeconomic status could be associated with dissatisfaction after THA[20–23]. However, there is a scarcity of reports from Asian countries about the association between postoperative satisfaction and physical activities during daily living or participation in sports.

Therefore, the purpose of this study was to investigate the level of patient satisfaction after THA and to identify significant factors influencing satisfaction in a Japanese cohort. We hypothesized that self-reported physical activities are correlated with postoperative satisfaction and associated with objectively measured physical performance measures including muscle strength and daily step counts.

PARTICIPANTS AND METHODS

Consecutive cases of primary THA for osteoarthritis at our hospital between January 2012 and January 2016 were included in this study. Exclusion criteria were: 1) previous hip surgery, 2) contralateral THA within the past one year, and 3) bed rest for other medical conditions. This study was approved by our Institutional Review Board (ID number: 30-246) and signed informed consent for participation was obtained from all patients.

Questionnaires were sent to 446 Japanese patients (Fig. 1), and valid responses were obtained from 285 patients (63.9% response rate) (Table 1). The postoperative follow-up period for patients who completed and returned the questionnaire was 43 ± 16 months (range: 12−84 months). Although the questionnaire was not anonymous—patients clearly stated their name when filling out the survey—patients completed the survey in the privacy of their home without being monitored by an

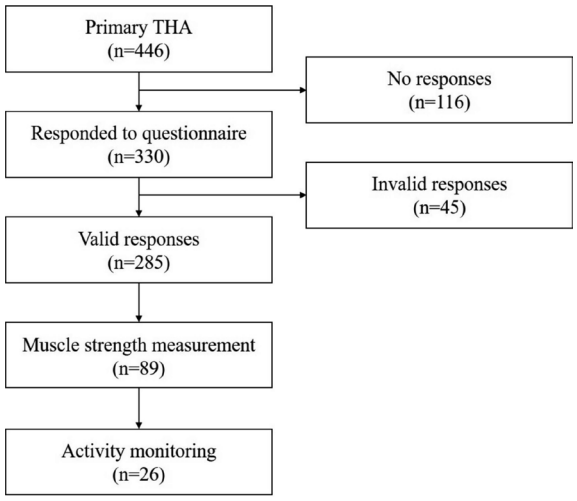

Fig. 1. Schematic representation of the study cohort inclusion process and study design.

Table 1. Demographic data for study participants

	All participants	Muscle strength measurement	Activity monitoring
	n=285	n=89	n=26
Age (years)	69.1 ± 9.9 (33–89)	68.3 ± 9.7 (42–89)	64.3 ± 6.6 (50–76)
Gender (male/female)	33/252	20/69	3/23
Height (cm)	153.1 ± 10.4 (147.7–176.2)	154.2 ± 6.8 (149.2–171.5)	159.7 ± 5.5 (151.7–176.4)
Weight (kg)	55.7 ± 7.1 (44.1–66.7)	56.1 ± 5.2 (46.2–68.1)	57.5 ± 6.8 (45.3–65.5)
BMI (kg/m^2)	23.8 ± 3.7 (16.2–42.4)	23.6 ± 3.3 (16.3–34.8)	22.5 ± 3.1 (15.6–29.5)
State of the contralateral side (Healthy/OA/THA)	28/83/74	11/52/26	8/14/4
Follow-up period (months)	43 ± 16 (12–84)	45 ± 12 (17–75)	11 ± 3 (6–18)

Values are mean ± standard deviations (range). BMI: Body mass index; OA: osteoarthritis; THA: total hip arthroplasty.

inspector. The survey was returned later. Postoperative satisfaction was rated on a 4-point scale of "very satisfied", "somewhat satisfied", "somewhat dissatisfied", and "very dissatisfied"[24]. Each question was weighted equally, and a satisfaction summary score was calculated (range 1–100; higher scores corresponding to greater satisfaction). Nominal responses of "very satisfied", "somewhat satisfied", "somewhat dissatisfied", and "very dissatisfied" corresponded to scores of 100, 75, 50, and 25, respectively, for each satisfaction question in each of the domains of a) pain relief, b) improving ability to do housework or yard work, c) improving ability to do recreational activities, and d) overall satisfaction with surgery. The total average satisfaction score was calculated by adding the scores for the 4 satisfaction questions and dividing them by 4. If any individual component was missing, a total score was not calculated. Postoperative Oxford hip score (OHS)[25], SF-12 Mental Component Summary (MCS)[26], and pre-and postoperative University of California Los Angeles (UCLA) activity score[27] were also surveyed. OHS assesses the pain and function of the hip during daily activities, whereas the UCLA activity score measures physical activity levels including sports participation.

Of the 285 patients, 89 (31.2%) were randomly selected for the assessment of maximal voluntary isometric muscle strength in concentric conditions using a hand-held dynamometer (HHD: μ-Tas F1; ANIMA Inc, Tokyo, Japan) (Fig. 1, Table 1). Hip abductor, flexor, and knee extensor strengths were quantified by well-trained physiotherapists with more than a year of experience in moment testing[28, 29] (Fig. 2). Two trials were performed after one practice in all examinations, with the highest peak torque (Nm/kg) used for the analysis.

Of the 89 patients, 26 (30%) were randomly selected for the objective assessment of physical activity using a tri-axial accelerometer monitor (activPAL3; PAL Technologies Ltd, Scotland, UK)[30] (Fig. 1, Table 1). The activity monitor was continuously worn at mid-thigh for seven days, except while bathtub or shower bathing (Fig. 3). ActivPAL3 has been demonstrated to be a valid and reliable device for measuring free-living physical activity, including daily step counts[31, 32]. The number of steps and standings obtained for one week were averaged per day.

A total satisfaction score of 100 was classified as "very satisfied", 75–99 as "somewhat satisfied", 50–74 as "somewhat dissatisfied", and 25–50 as "very dissatisfied". Patients whose overall satisfaction level was judged to be "very satisfied" were defined as the "very satisfied" group, and patients whose overall satisfaction level was judged to be other than "very

Fig. 2. Postoperative muscle strength measurement in total hip arthroplasty patients. During measurement of hip abductor strength, patients were supine with hip and knee in a neutral position (A). A force sensor (μ-Tas F1) was placed 5 cm proximal to the lateral epicondyle of the femur. During measurement of hip flexor (B) and knee extensor (C) strengths, patients were seated with straps across the waist and thighs.

Fig. 3. Postoperative activity monitoring in total hip arthroplasty patients. Daily step counts were taken for one week using an accelerometer-based activity monitor (activPAL3). A front view of the thumb-sized monitor placed on the anterior aspect of the mid-thigh using a surgical dressing is shown.

satisfied" were defined as the "other" group. Postoperative OHS-pain and ADL, SF-12 MCS, and pre-and postoperative UCLA activity scores were compared between "very satisfied" and "other" groups using the student's t-test. Multiple logistic regression analysis was used to identify independent factors associated with postoperative satisfaction[24]. Analyzed factors included patient characteristics (age, gender, body mass index, and follow-up period), QOL (OHS-pain, SF-12 MCS), and activity (OHS-ADL and postoperative UCLA activity score). Multivariate analysis was performed using stepwise multiple regression analysis to examine the influence of factors including patient characteristics and physical function (hip range of motion [ROM] and muscle strengths) on postoperative OHS-ADL and UCLA activity scores. Spearman's correlation coefficients were used to analyze the relationship between OHS-ADL and step counts per day measured by the activity monitor. All statistical analyses were performed using JMP® Pro 15 (SAS Institute Inc., Cary, NC, USA) with a significance level set at 0.05.

RESULTS

The number and percentage of respondents for each question in the satisfaction questionnaire are shown in Table 2. The overall satisfaction classification was "very satisfied" in 136 cases (47.7%), "somewhat satisfied" in 134 cases (47.0%), "somewhat dissatisfied" in 10 cases (3.5%), and "very dissatisfied" in 5 cases (1.8%). Combining "very satisfied" with "somewhat satisfied", 94.7% of the patients were satisfied with their primary THA.

OHS-pain (23.1 ± 0.2 vs. 21.1 ± 0.2, p=0.03) and OHS-ADL (23.1 ± 0.2 vs. 20.4 ± 0.2, p=0.02) were significantly higher in the "very satisfied" group compared to the "other" group (Table 3). There was no significant difference in SF-12 MCS between the "very satisfied" and "other" groups (58.1 ± 0.7 vs. 56.2 ± 0.7, p=0.83). Postoperative UCLA activity score was significantly higher in the "very satisfied" group compared to the "other" group (5.8 ± 0.1 vs. 4.6 ± 0.2, p=0.02). Multivariate analysis showed that higher postoperative OHS-ADL (p<0.01) and UCLA activity score (p=0.02) were significantly associated with higher postoperative satisfaction (Table 4).

Muscle strength measurements were 0.6 ± 0.2 Nm/kg (range: 0.2–1.1 Nm/kg), 0.8 ± 0.2 Nm/kg (range: 0.4–1.4 Nm/kg), and 1.0 ± 0.3 Nm/kg (range: 0.5–1.7 Nm/kg) for hip abduction, hip flexion, and knee extension, respectively. Multivariate analysis showed that younger age (p=0.02) and hip abductor strength (p=0.04) were significantly associated with higher postoperative ohs-adl (Table 5). Younger age (p<0.01), male gender (p=0.03), and larger hip abductor strength (p=0.01) were significantly associated with higher postoperative UCLA activity score (Table 6).

The mean number of steps and standings per day were 6,493 ± 2,301 steps (range: 2,353–16,732 steps) and 62 ± 18 times (range: 21–97 times), respectively. The mean number of steps showed a significant positive correlation with postoperative OHS-ADL (r=0.48, p=0.02), while the mean number of standings showed no significant correlation (r=−0.11, p=0.62) (Fig. 4). There was a ceiling effect for OHS-ADL (30.7% of patients having maximum scores of 24).

Table 2. Satisfaction questions and distribution

Satisfaction with procedure	n=285; n (%)
Q1. Pain relief	
Very satisfied	221 (77.5)
Somewhat satisfied	56 (19.6)
Somewhat dissatisfied	6 (2.1)
Very dissatisfied	2 (0.7)
Q2. Improving the ability to do housework or yard work	
Very satisfied	225 (78.9)
Somewhat satisfied	52 (18.2)
Somewhat dissatisfied	6 (2.1)
Very dissatisfied	2 (0.7)
Q3. Improving the ability to do recreational activities	
Very satisfied	161 (56.4)
Somewhat satisfied	109 (38.2)
Somewhat dissatisfied	12 (4.2)
Very dissatisfied	3 (1.1)
Q4. Overall satisfaction with surgery results	
Very satisfied	153 (53.6)
Somewhat satisfied	121 (42.4)
Somewhat dissatisfied	8 (2.8)
Very dissatisfied	3 (1.1)

DISCUSSION

The most important finding of this study is that postoperative physical activity during daily living and sports significantly influence patient satisfaction and were associated with hip abductor strength. Additionally, we found that self-reported physical activity levels were significantly associated with objectively measured daily step counts.

Approximately 95% of the Japanese patients were very satisfied or somewhat satisfied with the results of their primary THA. The excellent rate of satisfaction in this study is generally consistent with the previously reported 85–93% satisfaction rate in Western cohorts[18, 19, 33]. Halawi et al. reported that the frequent causes of patient dissatisfaction after THA were pain and functional limitations[34]. Meira et al. also reported that patients had high expectations before surgery for increased postoperative activity, including sports participation[35]. However, there have been few reports on the relationship between postoperative satisfaction and activity levels associated with daily living or sports participation in an Asian cohort. In this study, younger age and larger hip abductor strength were significantly related to both higher OHS-ADL and UCLA activity scores. In the present cohort, excellent post-operative recovery of isometric hip abductor strength was achieved with values of 0.6 Nm/kg in patients with an average age of 68.3 years. This observed hip abductor strength after THA is comparable to the reference value of 0.57 Nm/kg at an average age of 67.6 years[36]. In another study, Nankaku et al. reported that hip abductor strength after THA in a Japanese cohort with good ambulation was 0.54 Nm/kg with an average age of 56.7 years[37]. The impact of hip abductor strength on postoperative THA outcomes has been discussed extensively, and its importance is indisputable. Rudiger et al. proposed that an accurate reconstruction of femoral offset contributes to the ability of the

Table 3. Comparison of self-reported measures between "very satisfied" and "other" groups

	"Very satisfied" group (n=136)	"Other" group (n=149)	p value
OHS			
Pain (0–24)	23.1 ± 0.2 (12–24)	21.1 ± 0.2 (8–24)	0.03*
ADL (0–24)	23.1 ± 0.2 (12–24)	20.4 ± 0.2 (7–24)	0.02*
SF-12			
MCS	58.1 ± 0.7 (34.3–72.3)	56.2 ± 0.7 (26.4–81.4)	0.83
UCLA activity score			
Preoperative (1–10)	3.9 ± 0.2 (1–10)	3.9 ± 0.2 (1–10)	0.51
Postoperative (1–10)	5.8 ± 0.1 (3–10)	4.6 ± 0.2 (1–10)	0.02*

OHS: Oxford hip score; ADL: activity of daily living; MCS: mental component summary; UCLA: University of California Los Angeles. Values are mean ± standard deviations (range); * indicates statistically significant. p value <0.05.

Table 4. Factors influencing satisfaction after THA

Factors	Odds ratio	95% CI		p value
		Lower	Upper	
Patient characteristics				
Age	0.99	0.95	1.02	0.59
Gender	0.68	0.22	2.03	0.49
BMI	1.01	0.92	1.11	0.71
Contralateral surgical history	1.64	0.75	3.57	0.13
Follow-up period	0.8	0.71	1.48	0.41
QOL				
OHS-Pain	1.19	0.98	1.44	0.07
SF-12 MCS	1.03	0.99	1.07	0.06
Activity level				
OHS-ADL	1.42	1.16	1.73	<0.01*
UCLA activity score	1.27	1.04	1.55	0.02*

THA: total hip arthroplasty; CI: confidence interval; BMI: body mass index; OHS: Oxford hip score; MCS: mental component summary; QOL: quality of life; ADL: activity of daily living; UCLA: University of California Los Angeles. * indicates statistically significant. p value <0.05.

Table 5. Factors influencing OHS-ADL after THA

Factors	95% CI		β	p value
	Lower	Upper		
Patient characteristics				
Age	−0.13	−0.01	−0.22	0.02*
Gender	−0.65	1.39	0.08	0.90
BMI	0.12	−0.32	−0.17	0.20
Contralateral surgical history	−1.41	0.51	−0.13	0.36
Physical function				
ROM of the hip joint				
Flexion	−0.04	0.09	0.09	0.56
Abduction	−0.15	0.05	−0.11	0.71
External rotation	−0.04	0.10	0.09	0.34
Muscle strength				
Flexion of hip joint	−0.17	0.22	0.02	0.59
Abduction of hip joint	0.02	0.49	0.32	0.04*
Extension of knee joint	−0.27	0.04	−0.22	0.23

OHS: Oxford hip score; ADL: activity of daily living; THA: total hip arthroplasty; BMI: body mass index; CI: confidence interval; ROM: range of motion. * indicates statistically significant. p value <0.05.

Table 6. Factors influencing UCLA activity score

Factors	95% CI		β	p value
	Lower	Upper		
Patient characteristics				
Age	−0.06	0.01	−0.11	<0.01*
Gender	0.42	1.83	0.37	0.03*
BMI	−0.22	0.01	−0.21	0.28
Contralateral surgical history	−0.77	0.41	−0.08	0.46
Physical function				
ROM of the hip joint				
Flexion	−0.01	0.08	0.19	0.71
Abduction	−0.08	0.05	−0.05	0.39
External rotation	−0.06	0.02	−0.08	0.89
Muscle strength				
Flexion of hip joint	−0.13	0.12	−0.01	0.83
Abduction of hip joint	−0.09	0.21	0.10	0.01*
Extension of knee joint	−0.10	0.09	−0.01	0.37

UCLA: University of California Los Angeles; BMI: body mass index; CI: confidence interval, ROM: range of motion. * indicates statistically significant. p value <0.05.

abductor muscle lever arm to maintain normal gait[38]. Fukushi et al. previously reported that preoperative muscle strength and reconstruction of hip center affect the recovery of the hip abductor strength after THA[28]. Therefore, appropriate timing of surgery, refinements of surgical techniques, and intensive rehabilitation are suggested to be important to further increase both patient satisfaction and activity levels with the improvement of muscle strength.

In contrast to the physical outcomes, the mental outcomes measured using SF-12 MCS showed no significant difference between the "very satisfied" and the "other" groups. Palazzo et al. reported that a patient's postoperative mental wellbeing was significantly related to the fulfillment of their preoperative expectations of the THA surgery[39]. On the other hand, Shiomoto et al. stated SF-12 MCS had no significant effect on patient's perception of their joint function after THA in a Japanese cohort[5]. Another observation of the lack of correlation between SF-12 MCS and satisfaction score after primary THA was reported by Goodman et al[33]. Comparable postoperative SF-12 MCS scores between primary and revision THA cohorts were reported by Harada et al.; however, revision surgery due to infection was negatively associated with SF-12 MCS[40]. Although

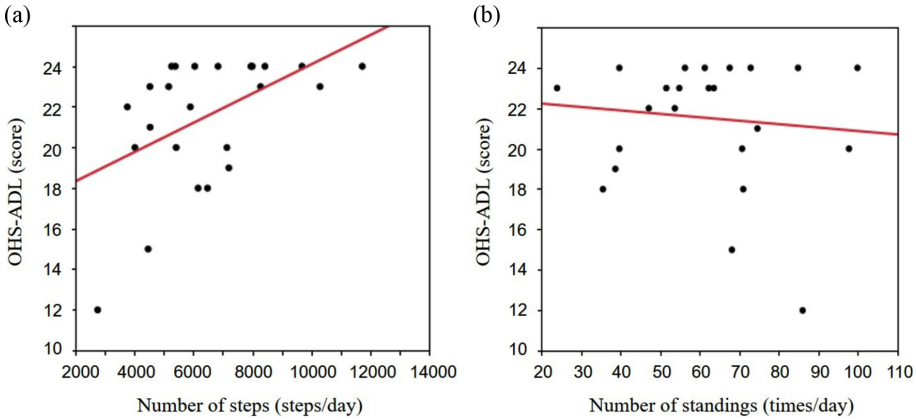

Fig. 4. Postoperative activity levels in total hip arthroplasty patients. The relationship between postoperative Oxford hip score-activities of daily living and the number of steps per day representing the significant association between self-reported and objectively measured physical activities. Postoperative Oxford hip score-activities of daily living were significantly correlated with the number of steps per day (a), but not with number of standings per day (b).

a pessimistic outlook has been reported to influence a patient's postoperative outcomes, the present study did not reveal an association between mental outlook and postoperative clinical outcomes after primary THA.

To date, there is limited information about the daily step counts following THA in Asian patients. Objective activity measurement in the present study revealed 6,493 steps/day on average. The step counts measured in this study are somewhat higher than those previously reported for healthy elderly individuals in Japan. The Ministry of Health, Labour, and Welfare of Japan reported that the average step count in 65 years or older Japanese males was 5,597 steps and Japanese females was 4,726 steps[41]. Doppelbauer et al. reported that the mean number of daily steps immediately before discharge following THA was 2,165 ± 1,570 steps[42], and Kuhn et al. reported that the mean number of daily steps one year after THA was 5,584 ± 1,626 steps[43]. Therefore, the amount of physical activity observed in patients after THA in the present study is equivalent to or higher than these previously reported activity levels in studies from Europe and the United States. Additionally, the relationship between subjective and objective measures of physical activity levels was examined in the present study. Greater daily step counts under a free-living environment were associated with better self-reported functional activity levels. On the contrary, Jacobsen et al. reported discrepancies between self-reported physical activity and objectively measured physical activity in patients with hip dysplasia[44]. Nevertheless, providing feedback on muscle strength and/or step counts to the patients using hand-held dynamometer and/or an activity monitor may help achieve a better QOL after THA. It should be noted that 30.7% of the postoperative ceiling effect was identified for OHS-ADL in this study. Consistent with our finding, the ceiling effect for OHS after THA was reported as 31% to 36.4% by previous studies[45, 46]. The fact that sensor-based physical activity monitor with no ceiling effect is more effective in objective quantity assessment after THA has a certain clinical significance.

Our study has several limitations. First, it was not possible to standardize the follow-up period for patients. Nevertheless, we attempted to compensate for this deficiency by analyzing the follow-up period as a variable in the statistical analysis, which allowed measurement of the conditions of a large number and wide range of patients. Second, the number of cases in which muscle strength and daily step counts were assessed was relatively small. However, despite the low sample size, the results of this study significantly deepen the understanding of patient satisfaction after THA. We have not been able to ascertain the details of patients' daily life and sports activities. However, we believe that the results obtained in this study will serve as a foundation for follow-up studies.

In conclusion, approximately 95% of the patients were very satisfied or somewhat satisfied with the results of primary THA. Significant correlations were observed between patient satisfaction and subjective assessment of daily and sports activities. OHS-ADL was significantly related to hip abductor strength and objectively measured daily step counts. However, postoperative SF-12 MCS was not significantly associated with patient satisfaction. These findings provide a framework for counseling patients undergoing THA about the importance of muscle strength and physical activity levels in their postoperative recovery.

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Conflicts of interest

The authors have no conflict of interest to declare.

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