



Original Article

Differences in preoperative function and outcome of patients with versus without sarcopenia after total hip arthroplasty

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Abstract. [Purpose] Public attention regarding sarcopenia has increased in recent years. Patients with sarcopenia reportedly show worse return home rates and activities of daily living at discharge. However, no reports have described the function and outcomes of hip osteoarthritis patients with sarcopenia after total hip arthroplasty. This study aimed to clarify differences in preoperative physical function and outcomes of hip osteoarthritis patients with versus without sarcopenia after total hip arthroplasty. [Participants and Methods] Twenty-five patients with hip osteoarthritis who underwent total hip arthroplasty were included. Evaluation items were preoperative skeletal muscle mass of the extremities, isometric strength of the lower extremities (hip abduction and knee extension), grip strength, and the 10-m timed gait test results. [Results] The prevalence of sarcopenia was 8% (2/25 patients). The sarcopenic group displayed lower skeletal muscle mass index, grip strength, and 10-m timed gait test values. The sarcopenic group showed lower muscle mass in the upper and lower limbs and trunk and lower hip abductor strength than the non-sarcopenic group. [Conclusion] Eight percent of patients developed sarcopenia after total hip arthroplasty. Due to the low average age (66.0 ± 9.5 years), the prevalence was lower than that of other orthopedic diseases.

Key words: Hip osteoarthritis, Sarcopenia, Total hip arthroplasty

(This article was submitted Aug. 20, 2021, and was accepted Oct. 25, 2021)

INTRODUCTION

In recent years, the situation surrounding total hip arthroplasty (THA) has been changing dramatically. Improvements in surgical techniques and the introduction of clinical pathways have led to the expectation of early ambulation and recovery of muscle strength. These changes have in turn contributed to shorter hospitalization and savings in medical costs¹⁾. A recent study regarding THA found that the mean duration of hospitalization has shortened year after year, due to advances in surgical techniques and the introduction of the concept of enhanced recovery after surgery²⁾. According to a recent meta-analysis³⁾, mean durations of hospitalization early discharge within a few days is common in the United States. While other countries show lengths of varying by country. Previous studies^{4, 5)} have shown that preoperative conditions affect physical function recovery after THA. Preoperative assessment of physical function and appropriate interventions for early ambulation and discharge are therefore essential. Rooks et al.⁶⁾ reported that a 6-week preoperative exercise program before THA surgery in

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patients with hip osteoarthritis (OA) improved preoperative functional status and significantly reduced the rate of postoperative transfer to a rehabilitation facility.

Postoperatively, weakness of the hip abductor muscles is the main target of rehabilitation programs, because such weakness is a major risk factor in postoperative complications such as joint instability and loosening among persons with THA^{7,8)}.

Conversely, sarcopenia has also attracted attention in recent years, as described in many reports. The prevalence of sarcopenia among elderly Japanese aged ≥ 60 has been reported as 7.5–8.2%^{9, 10)}. Yoshida et al.⁹⁾ and Yoshimura et al.¹⁰⁾ showed that sarcopenia is associated with poor quality of life, falls, fractures, and decreased physical and cognitive function. Previous studies^{11, 12)} have recommended that sarcopenia should be treated by enhancing both exercise and nutrition. In the field of orthopedics, the prevalence of sarcopenia among Japanese individuals with spinal disorders has been reported as 46.6% for degenerative scoliosis¹³⁾, 16% for lumbar spinal stenosis¹³⁾, and 47.3% for hip fracture¹⁴⁾. Reports on sarcopenia in spinal diseases and proximal femur fractures have thus accumulated. These reports suggest that orthopedics patients show a very high relative prevalence of sarcopenia compared to the general Japanese population.

Therefore, if hip OA patients show sarcopenia preoperatively, recovery of function and ability is expected to be affected postoperatively. However, no reports appear to have examined sarcopenia among hip OA patients or have focused on function and outcomes among hip OA patients after THA from the perspective of sarcopenia. Considering the fact of sarcopenia in orthopedic diseases, the hypothesis of present study are as follows: 1) The prevalence of sarcopenia is high even in hip OA patients before THA surgery; 2) In the case of combined sarcopenia, it will take time for walking independence after THA surgery and the hospitalization period will be longer. The purpose of this study was to clarify differences in preoperative physical function and outcome after THA among hip OA patients with and without sarcopenia.

PARTICIPANTS AND METHODS

The sampling method in this study was to check with the subjects in the order of surgery, and those who matched were selected. Inclusion criteria were patients who underwent initial unilateral THA. The total number of patients who met the inclusion criteria was 25 (1 male, 24 females). The stage of hip OA was progressive in 19 cases and terminal in 6 cases. Patient background factors are shown in Table 1. Exclusion criteria were as follows: patients with dementia, depression, or schizophrenia; patients with implantation of a metallic device or cardiac pacemaker; or patients with a major complication after surgery (hip dislocation, fracture, or any trauma due to falls), subsidence of femoral component, fibula neuropathy. Two patients were excluded from the study because of a subsidence of femoral component, fibula neuropathy, respectively.

Patients were operated on in the Department of Orthopedic Surgery at Showa University Fujigaoka Hospital between February 1 and December 31, 2019.

This study was conducted in compliance with the Declaration of Helsinki, and all study protocols were conducted with approval from the Showa University Fujigaoka Hospital Ethics Committee (approval no. F2020C10). All participants provided informed consent using opt-out on the website of Showa University.

A retrospective, observational research design was used in this study.

Demographic data were collected from clinical records, including age, gender, body mass index (BMI), diagnosis, surgical procedure (posterolateral (PL) or anterolateral-supine (ALS)) and presence or absence of sarcopenia.

Evaluation items were preoperative skeletal muscle mass of the extremities, isometric strength of the lower extremities (hip abduction and knee extension), grip strength, and the 10-m timed gait test. Skeletal muscle mass index (SMI) was measured for all patients using bioelectrical impedance analysis (BIA) (InBody S10; InBody Japan, Tokyo, Japan). Participants were measured after 2 min of rest in a supine position, and were instructed not to move or speak during measurement. Fujimoto et al.¹⁵⁾ reported that BIA was easily performed without needing any radiation exposure. Skeletal muscle mass index was determined according to the methods described by Baumgartner et al.¹⁶⁾, as the limb muscle mass in kilograms divided by the square of the height in meters. Isometric muscle strength on both sides was measured in all participants using a hand-held dynamometer (μ Tas; Anima Co., Tokyo, Japan). Torque-body weight ratio was also measured in newton-meters

Table 1. Demographic data of patients

	Non-sarcopenia (n=23)	Sarcopenia Case A	Sarcopenia Case B
Gender (male:female)	1:22	Female	Female
Age (years)	64.9 \pm 9.1	76	81
Height (cm)	154.7 \pm 6.1	153	151
Weight (kg)	57.0 \pm 10.2	53	50
BMI (kg/m ²)	23.8 \pm 3.9	22.6	21.9
Surgical procedure (ALS:PL)	11:12	PL	PL
Mean \pm SD.			

per kilogram. Hip abductor and knee extensor muscle strength were measured preoperatively. Hip abductor and knee extensor muscle strengths were measured twice on both the surgical and non-surgical sides, with maximum values adopted for analysis. Torque-body weight ratio was calculated using the moment arm of the joint and isometric muscle strength. Moment arm of the hip joint was taken as the spinomalleolar distance. Moment arm of the knee joint was taken as the distance between the knee joint lateral space and the lateral malleolus of the ankle. Hip abductor muscle strength was measured in the supine position. The handheld dynamometer was placed lateral to the fibula, 2.5 cm proximal to the malleolus. Knee extensor muscle strength was measured in the sitting position. The handheld dynamometer was placed anterior to the fibula, 2.5 cm proximal to the malleolus. Each test was performed three times, with the highest value adopted for analysis. Grip strength was measured using a Smedley-type grip dynamometer (Grip-D, T.K.K.5401; Takei Scientific Instruments Co., Niigata, Japan). Measurement was performed twice on the dominant hand in a stable standing posture. Each test was performed twice, with the highest value used for analysis. The 10-m timed gait test was performed using a 16-m straight gait lane containing a 3-m approach lane and a 3-m supplement lane.

The criteria of the Asian Working Group for Sarcopenia¹⁷⁾ was used to diagnosis sarcopenia. The following values were used as standard values to define sarcopenia: SMI, <7.0 kg/m² for males, and <5.7 kg/m² for females; grip strength, <26 kg for males, and <18 kg for females; and gait speed, <0.8 m/s.

The purpose of this study was to compare the characteristics of the sarcopenia groups to non-sarcopenia groups. However, due to the small number of cases in the sarcopenia group, statistical processing for comparison between the two groups could not be performed. Therefore statistical analysis was performed using descriptive statistics. For the 23 patients in the non-sarcopenia group, results are shown as mean ± standard deviation. Raw data are shown for the two cases in the sarcopenia group.

RESULTS

Sarcopenia was seen in 2 of the 25 cases (prevalence, 8%). Twenty patients (80%) were discharged to home, and 5 (20%) were transferred to a convalescent hospital. Both patients in the sarcopenia group were transferred to a convalescent hospital. The use of a walking assist device in the preoperative period is summarized in Table 2. Physical functions and SMI are shown in Table 3.

In the non-sarcopenia group, mean muscle strength and muscle mass were as follows: grip strength, 24.6 ± 6.5 kgF; hip abduction muscle strength (operated side/non-operated side), 0.60 ± 0.05/0.99 ± 0.13 Nm/kg; and knee extension muscle strength (operated side/non-operated side), 0.66 ± 0.1/0.88 ± 0.11 Nm/kg; SMI, 6.4 ± 0.8 kg/m²; and muscle mass in each branch (upper limb/lower limb/trunk), 3.6 ± 0.7/11.8 ± 2.0/16.7 ± 2.3 kg. The 10-m timed gait test was 1.4 ± 0.4 m/s.

Results for sarcopenia cases (Cases A and B) are shown in Table 3. In the sarcopenia group, muscle strength and muscle mass were as follows: grip strength, 16.7 and 16.8 kgF; hip abduction muscle strength (operated side/non-operated side), 0.39

Table 2. Preoperative use of walking assist devices

	Non-sarcopenia (n=23)	Sarcopenia (n=2)
Non-cane	20	
Cane	2	2
Lofstrand cane	1	

Table 3. Physical function and SMI

	Non-sarcopenia (n=23)	Sarcopenia Case A	Sarcopenia Case B
Grip strength (kgF)	24.6 ± 6.5	16.8	16.7
10-m timed gait test (m/s)	1.4 ± 0.4	1.3	0.98
SMI (kg/m ²)	6.4 ± 0.8	5.5	5.5
Muscle mass (kg) [upper limb/lower limb/trunk]	3.6 ± 0.7/11.8 ± 2.0/16.7 ± 2.3	2.6/10.4/13.4	2.8/9.8/14
Hip abduction muscle strength (Nm/kg) [operated side/non-operated side]	0.60 ± 0.05/0.99 ± 0.13	0.56/0.93	0.39/0.68
Knee extension muscle strength (Nm/kg) [operated side/non-operated side]	0.66 ± 0.1/0.88 ± 0.11	0.54/0.66	0.67/1.06

Mean ± SD.

and 0.56/0.68 and 0.93 Nm/kg; and knee extension muscle strength (operated side/non-operated side), 0.54 and 0.67/0.68 and 0.93 Nm/kg; SMI, 5.5 and 5.5 kg/m²; and muscle mass in each branch (upper limb/lower limb/trunk), 2.6 and 2.8/9.8 and 10.4/13.4 and 14.0 kg. Results for the 10-m timed gait test were 0.98 and 1.3 m/s.

In addition to SMI, grip strength and 10-m timed gait test, which are criteria for determining sarcopenia, sarcopenic patients also displayed lower muscle mass in the upper and lower extremities and trunk, and lower hip abductor strength compared to non-sarcopenic patients.

DISCUSSION

In individuals undergoing THA, previous studies^{4, 5)} have shown that preoperative conditions affect the recovery of physical function after surgery. Assessing and intervening in physical function before surgery is important to achieve early ambulation and discharge from the hospital. In this study, the prevalence of sarcopenia was 8%. Akune et al.¹⁸⁾ found that the prevalence of sarcopenia among community-dwelling elderly Japanese was 13.8% for males (mean age, 75.7 years) and 12.4% for females (74.4 years), and prevalence increased with age. On the other hand, in orthopedics, the prevalence of sarcopenia among Japanese spinal disorders has been reported as 46.6% for degenerative scoliosis (74.8 years)¹³⁾, 16% for lumbar spinal stenosis (72.9 years)¹³⁾, and 47.3% for hip fracture (male: 82.7 years; female: 80.3 years)¹⁴⁾. Ages of the two patients with sarcopenia were 76 and 81 years, similar to the previous studies^{13, 14, 18)}. The prevalence of sarcopenia was lower in this study than in previous studies of other diseases in orthopedics. This might be attributable to the fact that the average age of participants in this study was 65 years, younger than in previous studies.

Compared with the non-sarcopenia group, the sarcopenia group showed lower SMI, muscle mass in each limb, and hip joint strength. Furthermore, the sarcopenia group showed delayed achievement of independence among patients walking with a cane. The sarcopenia group displayed low SMI and lower limb muscle strength, and these functional deficits may have prevented improvements in gait function. Yoshimura et al.¹⁹⁾ reported that sarcopenia patients showed a lower discharge-to-home rate and lower ADL at discharge. In this study, results were similar to those described by Yoshimura et al. Regarding the surgical approach, Ukai et al.²⁰⁾ reported a comparison of ALS and PL approaches, external rotation muscle strength of the hip joint was significantly weaker in the PL approach until half a year postoperatively. In addition, The ALS group started using a cane earlier and showed a shorter hospital stay. In this study, both patients in the sarcopenia group were treated using the PL approach, and the surgical techniques might have been affected in a similar manner to those in the study by Ukai et al.²⁰⁾.

A combination of exercise and nutritional interventions is recommended for frail elderly and sarcopenic patients^{11, 12, 19-22)}. Sarcopenia cases in this study were living in the community and preoperative ADL was independent. However, whole-body muscle mass was reduced, so a long time might be required to gain a stable gait after THA. Evaluation with or without sarcopenia before THA is therefore important, affecting the time required for physical function and gait improvement after surgery as well as the length of hospitalization. If appropriate criteria could be devised to identify sarcopenia before THA, the same intervention (a combination of exercise and nutrition) used for elderly individuals with sarcopenia maybe effective to increase SMI and muscle strength to achieve stable gait. Although physical therapists specialize in exercise therapy, we should also consider collaborating with dietitians as nutritional specialists, to optimize the use of nutrition supplements.

In the future, we would like to increase the number of cases to clarify the prevalence of sarcopenia among THA patients and to further investigate the relationship between physical function and sarcopenia in THA.

In conclusion, the prevalence of sarcopenia among patients after THA was 8%. Due to the relatively young mean age of participants, the prevalence was lower than that in patients with other orthopedic diseases. In older patients at risk of sarcopenia, the combination of exercise and nutrition intervention after THA may be efficient for increasing SMI and muscle strength.

Limitations of this study were as follows: 1) the number of cases was small, and data could not be treated as representative values for hip OA patients who underwent THA; 2) since the sarcopenia group included only two cases, statistical analysis was not feasible; and 3) no consideration was given to pain or leg length, which may affect gait or muscle strength.

Conflict of interest

There are no conflicts of interest to disclose in this study.

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