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Recreational sports, workout and gym activities after total knee arthroplasty: Asian cohort study

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ABSTRACT

This study aimed to evaluate sports activities after total knee arthroplasty in an Asian cohort using 2011 Knee Society scoring system. The average scores for satisfaction and expectation about sports-related activities were 4.9 (61%) and 3.5 (70%), respectively. Most patients mainly opted for low-impact sports. Multivariate analysis showed that higher score of 'standard activities' and 'walking & standing', better range of motion, and older age were associated with higher scores of satisfaction and expectation about sports-related activities. In conclusion, improvement of activities of daily living could provide higher satisfaction and expectation about performing recreational sports, workout and gym activities.

1. Introduction

Total knee arthroplasty (TKA) has become a successful surgical procedure for patients with symptomatic end-stage knee arthritis because of advancement in surgical techniques, prosthetic design, polyethylene manufacturing, and rehabilitation.[1] However, patient-reported scoring systems have revealed that less than 90% of patients are satisfied with the results of TKA.[2–5] Various factors are reportedly associated with patient satisfaction, including general health, psychological state, and conditions of the replaced knee joint.[2–5] Matsuda et al.[3] reported that postoperative alignment and range of motion (ROM) in the knee joint affect overall patient satisfaction, and that old age, rheumatoid arthritis (RA), and limited ROM negatively correlate with functional activities after TKA. However, very little is known regarding the factors associated with satisfaction and expectation about performing sports-related activities in an Asian cohort. Therefore, we investigated (1) participation, patient satisfaction and expectation in recreational sports, workout and gym activities after TKA in Japanese patients using the 2011 Knee Society Score (KSS 2011),[6] and (2) which factors, including sex, age, body mass index (BMI), primary diagnosis, postoperative alignment, pain during activities of daily living, ROM in the knee joint, and functional outcomes, contribute to patient satisfaction and expectation about sports-related activities.

1.1. Patients and methods

Between November 2013 and September 2015, 101 Japanese patients with 110 knees underwent primary fixed-bearing TKA performed by same group of surgeons. Demographic data of the patients are shown in Table 1. Preoperative hip-knee-ankle (HKA) angle[7] was 9.4 ± 7.8° varus (range, 11.8 valgus–35 varus). Fifty knees in 42 patients had posterior-stabilized TKA (Persona, Zimmer-Biomet, Warsaw, IN, USA), and 60 knees in 54 patients had bi-cruciate stabilized TKA (JOURNEY II, Smith & Nephew, Memphis, TN, USA), depending of surgeons' preferences. All TKAs were performed using similar surgical techniques in terms of the mechanical alignment, using a medial parapatellar approach, and medial stabilizing technique.[8] Postoperative evaluation including ROM, coronal alignment, and patient-reported outcomes were performed with an average follow-up of 14.6 ± 4.4 months (8.7–28.1). ROM of the knee was measured with the application of a goniometer by the treating orthopaedic surgeon. No patient had a history of any complication after TKA. The methods of our study were approved by our institution's Review Board.

1.2. Evaluation of the coronal alignment

Coronal limb alignment was measured by drawing a mechanical axis on each femur and tibia depicted in a full leg-length standing radiograph. The knees were fully extended and positioned so that the

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Table 1
Demographic data.

Parameters	
Knees (n); Patients (n)	110 knees; 96 patients
Age at operation (years)	74 ± 7.8 (50–88)
Gender (male; female)	16 knees; 94 knees
BMI (kg/m^2)	26.9 ± 4.1 (18.4–41.6)
Diagnosis (OA; RA)	105 knees; 5 knees
Type of implanted prothesis (PS; BCS)	50 knees; 60 knees
Postoperative follow-up period (months)	14.6 ± 4.4 (8.7–28.1)
Postoperative ROM (°)	127 ± 10 (90–150)
Postoperative HKA angle (°)	0.7 ± 2.8 varus (7.3 valgus–10.6 varus)

Abbreviations: BMI: body mass index; OA: osteoarthritis; RA: rheumatoid arthritis; PS: posterior-stabilized; BCS: Bicruciate-stabilized; ROM: range of motion; HKA: hip-knee-ankle, Values are expressed as mean ± standard deviation (range) or number of knees as appropriate.

patella was centred between the femoral condyles and facing forward. The HKA angle was defined as the coronal angle between the mechanical axes of the femur and the tibia.[7] Positive and negative values were expressed as varus and valgus, respectively. To test intra- or inter-observer reliability, measurement of the HKA angle was performed two times by one examiner at intervals > 1 week and once by two examiners on ten images randomly selected from the study group. The intra- and inter-class correlation coefficients were 0.97 and 0.92 for measurement of the HKA angle, indicating excellent reliability.

1.3. Patient-reported outcomes

Postoperative patient-reported outcomes were assessed using the KSS 2011.[5] The subjective component of KSS 2011 evaluates the following: symptoms, satisfaction, and functional activities (walking and standing, standard activities, advanced activities, and discretionary activities). The maximum possible score for each component of the KSS 2011 is as follows: 25 for 'symptoms'; 40 for 'patient satisfaction'; 15 for 'patient expectations'; 100 for 'functional activities'; 30 for 'walking and standing'; 30 for 'standard activities'; 25 for 'advanced activities'; and 15 for 'discretionary knee activities'.

1.4. Statistical analysis

The statistical analysis was performed using JMP Pro 12.2.0 (SAS Institute Inc, Cary, NC, USA). The unnecessary variables of sex, age, BMI, primary diagnosis, ROM, HKA, and scores of each item in the 'symptoms', 'walking and standing', 'standard activities', and 'advanced activities' categories were excluded in a stepwise procedure. Subsequently, we performed multivariate linear regression analyses to determine which factors affected three sports-related parameters: 'satisfaction while performing leisure recreational activities', 'expectation about leisure, recreational or sports activities', and 'discretionary knee activities'. We used linear regression analysis to determine the relationship between the significant factors and each sports-related parameter. P values of less than .05 were considered to be statistically significant.

2. Results

Patient-reported outcomes using the KSS 2011 were 20 (81%) ± 4 in symptoms, 27 (67%) ± 7 in patient satisfaction, 11 (71%) ± 3 in patient expectations, and 66 (66%) ± 19 in functional activities. With respect to the sports-related parameters, 'satisfaction while performing leisure or recreational activities', 'expectation about leisure, recreational or sports activities', and 'discretionary knee activities' were 4.9 (61%) ± 1.8, 3.5 (70%) ± 0.9, and 10 (66%) ± 4.6, respectively. Four, 11, and 71 patients (86 patients, 90%) of all 96 patients opted for 1, 2, and 3 activities, respectively, with the following score in each activity: 4.1 (81%). Low-impact sports[9–11] like stretching, gardening, walking, swimming, and cycling were selected by 74, 56, 51, 22, and 18 patients, respectively (Fig. 1). High-impact sports[9–11] like jogging and racket sports were selected by 7 and 2 patients, respectively.

Multivariate analysis showed that higher score of 'standard activities' and better ROM were associated with higher 'satisfaction while performing leisure recreational activities' (Table 2). Significant moderate correlation was noted between 'standard activities' and 'satisfaction while performing leisure or recreational activities' scores (correlation coefficient: CC 0.59, p < .0001) with correlation analysis using 95% confidence ellipse. Multivariate analysis showed that higher score of walking & standing, older age, and better ROM were associated with higher 'expectation about performing leisure, recreational or sports activities' (Table 3). Significant weak correlation was noted between 'walking and standing' and 'expectation about performing leisure, recreational or sports activities' scores (CC 0.34, p = .0003). Multivariate analysis showed that lower 'pain when using stairs or inclines' and younger age were positively associated with score of 'discretionary knee activities' (Table 4). Significant weak correlations were noted between scores of 'pain when using stairs or inclines' and 'discretionary knee activities' (CC 0.35, p = .0002) and between age and scores of 'discretionary knee activities' (CC -0.22, p = .0245).

3. Discussion

We reported reasonably well postoperative KSS 2011 scores: symptoms, 20 (81%); patient satisfaction, 27 (67%); patient expectation, 11 (71%); functional activities, 66 (66%). Matsuda et al.[4] previously reported the following KSS 2011 scores: symptoms, 19 (74%); patient satisfaction, 23 (59%); patient expectation, 10 (64%);

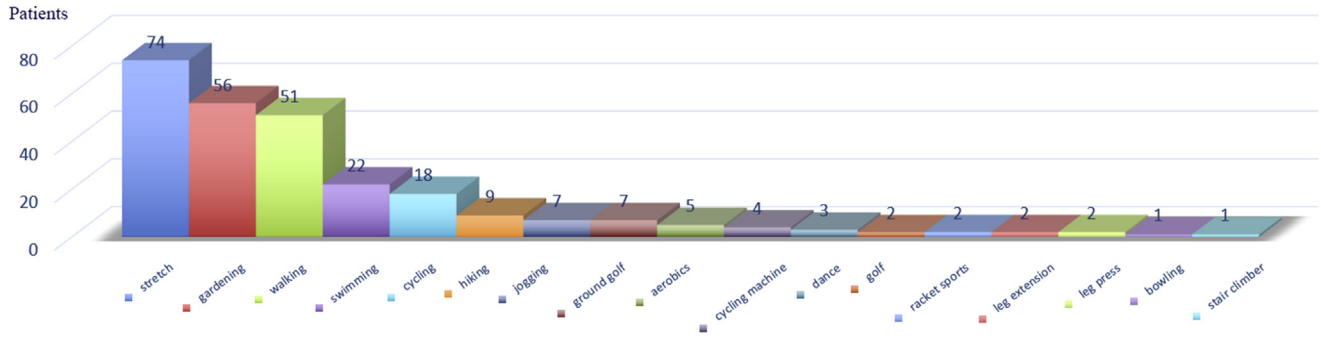

Fig. 1. Description of the recreational, workout and gym activities that patients participated in after total knee arthroplasty. Patients check maximum three of the discretionary knee activities that they consider most important to themselves as recreational activities (swimming; golfing; road cycling; gardening; racquet sports; distance walking; dancing/ballet; stretching exercises) and workout and gym activities (weight-lifting; leg extensions; stair-climber: stationary biking/spinning; leg press; jogging; elliptical trainer; aerobic exercises).

Table 2
Multivariate analysis in postoperative 'Satisfaction while performing leisure recreational activities' score in KSS 2011.

Factor	F-statistic	Positive effect	*p* value
'Pain with level walking' score in KSS 2011	1.87		0.1744
'Pain with stairs or inclines' score in KSS 2011	3.67		0.0581
'Standard activities' score in KSS 2011	13.43	High score	0.0004*
'Discretionary knee activities' in KSS 2011	2.41		0.1235
Gender (male; female)	1.33		0.2517
Postoperative ROM (°)	4.28	Large ROM	0.0411*

Abbreviations: KSS: Knee Society score; ROM: range of motion, * statistically significant p value $<$ .05.

Table 3
Multivariate analysis in postoperative 'Expectation to leisure, recreational or sports activities' score in KSS 2011.

Factor	F-statistic	Positive effect	*p* value
'Walking & standing' score in KSS 2011	13.64	High score	0.0004*
Age	5.59	Old patients	0.0199*
Postoperative alignment (varus; valgus)	2.34		0.1291
Postoperative ROM (°)	5.22	Large ROM	0.0244*

The 'expectation' score represents how much the patients feel their replaced knees met their preoperative expectations. *Abbreviations: KSS: Knee Society score; ROM: range of motion, * statistically significant p value $<$ .05.*

functional activities, 53 (53%), in a Japanese cohort. The present study additionally elucidated the factors associated with satisfaction and expectation about performing sports-related activities. Multivariate analysis showed that better scores of 'standard activities' and 'walking and standing' could lead to significantly better patient-derived satisfaction and expectation about performing recreational sports, workout and gym activities. Therefore, improvement of ease of performing fundamental activities of daily living based on functional recovery of the knee joint could have a spillover effect on other applied movements.

The present study showed that a majority of patients (90%) consider at least one recreational sport, workout, and gym activities as important. Most patients opted for low-impact sports like; stretching, gardening, walking, swimming, cycling, etc. Hopper et al.,[12] Barber-Westin et al.,[10] and Vielgut et al.[11] also reported that Western patients mainly participated in low-impact sports: walking, bicycling, and swimming, which were recommended as sports activities by specialists after TKA.[9,13] In this study, older patients showed a higher score of 'expectation about leisure, recreational or sports activities' and a lower score of 'discretionary knee activities'. Younger patients undergoing TKA might not have their expectation met despite achieving better knee function and physical activity because of a high level of expectation. Consistent with our findings, previous studies have found that older patients may preoperatively have lower expectation regarding functional outcomes of TKA compared to the young patients.[11,14] Parvizi J et al.[14] pointed out that older patients do not increase their activity levels following TKA despite significant reduction of pain. A highly significant correlation between the level of activity desired by the patient before surgery and the final level of activity was observed by Bonnin and colleagues.[15]

Greater postoperative ROM has been reported to correlate with better functional performance of patients after TKA.[4,6] Multivariate analysis performed in this study also showed that ROM positively associated with the score of 'expectation about leisure, recreational, or sports activities'. As previously mentioned, Matsuda et al.[4] reported that limited ROM, in addition to old age and RA, negatively correlated with functional activities after TKA. Ha et al.[5] also reported that greater flexion after TKA in Korean patients is correlated with improvements in clinical outcome and quality of life. Especially for patients from Asia and the Middle-east, deep knee flexion is an important function for many activities of daily living. Better ROM could be advantageous in various situations, including leisure, recreational, and sports activities.

There are several limitations in the present study. First, cohort includes two different knee designs. Because this is a retrospective study of a nonrandomized cohort, selection bias was present in the allocation of patients into the two surgical groups. Therefore, type of implanted prosthesis was excluded in the statistical analyses. Randomized control trial or propensity score matching with larger number of cohorts would be desirable to provide definitive conclusions in terms of the effect of two different knee designs. Second, there is no data about a difference in ethnicity between the Asian patients (i.e. Japanese vs. Chinese vs. Korean, etc.). Cultural differences could easily effect satisfaction and return to sporting activities even in Asia. Third, the study included only KSS 2011 score as the patient-derived scoring system, but objective measurement of actual physical activity level was not performed. The overall frequency, duration, and skill level of the activity are important, and these should be investigated in further studies.

4. Conclusion

We identified the factors associated with satisfaction and expectation about performing sports-related activities after TKA in Japanese patients. Improvement of ease of performing activities of daily living, based on functional recovery of the knee joint, could provide higher satisfaction and expectation about performing leisure, recreational, or sports activities. These data may be beneficial for advising patients about postoperative recreational and sports activities prognosis.

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Conflicts of interest

All authors declare that they have no conflicts of interest.

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Table 4
Multivariate analysis in postoperative 'Discretionary knee activities' score in KSS 2011.

Factor	F-statistic	Positive effect	*p* value
'Pain with stairs or inclines' score in KSS 2011	14.34	Low pain	0.0003*
Age	7.33	Young patients	0.0079*
Postoperative alignment (varus; valgus)	3.12		0.0806

Abbreviations: KSS: Knee Society score, * statistically significant p value $<$ .05.

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