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ORIGINAL ARTICLE

Difference in the degree of improvement in patient-reported outcomes after total knee arthroplasty between octogenarians and sexagenarians: a propensity score matching analysis

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Abstract

Background As the population ages, the use of primary total knee arthroplasty (TKA) is on the rise in the octogenarian population.

Aims The objective of this study was to compare patient-reported outcomes after TKA in octogenarians versus sexagenarians.

Methods This retrospective case-controlled comparative study with a propensity score matching analysis was conducted by 251 patients who underwent TKA for degenerative osteoarthritis of the knee. After the propensity score matching analysis, 38 octogenarians and 41 sexagenarians were identified. Range of motion (ROM), degree of flexion contracture, Charlson Comorbidity Index score, Knee Society score (KSS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, the 36-Item Short-Form Health Survey (SF-36), postoperative complications, length of stay, and 90-day mortality after TKA were compared. The degree of improvement of each functional parameter was also assessed.

Results There was no significant difference in the degree of improvement in postoperative ROM, flexion contracture, or KSS. There were only significant differences in length of hospital stay and volume of blood transfusion ($p < 0.001$ and $p = 0.004$, respectively). The octogenarian patient group showed significantly inferior outcomes for WOMAC and SF-36 score compared to the sexagenarian patient group ($p = 0.009$ and $p = 0.022$, respectively).

Conclusion Although the functional improvements after TKA were excellent regardless of age, TKA seemed to contribute little to quality of life in octogenarian patients. Therefore, a careful approach to improving satisfaction with subjective outcomes is needed for octogenarian patients who undergo TKA.

Keywords Octogenarian · Sexagenarian · Total knee arthroplasty · Patient-reported outcome

Introduction

The highest proportion of total knee arthroplasty (TKA) cases is observed in patients 65–74 years of age, but the greatest increase has been seen in those 75–84 years of age [1]. With improvements in general health care and attention and a high level of activities daily of living, the use of TKA has been widely accepted in elderly patients, while increasing confidence in TKA design and survivorship combined with increasing population longevity has resulted in more elderly patients requesting and undergoing TKA [2–5].

Although older patients were willing to undergo joint arthroplasty as younger patients, most orthopedic surgeons have concerns about performing TKA in elderly patients due to higher rates of postoperative complications, longer hospital stays, and mortality despite significant pain relief and improved functional outcomes of joint arthroplasty [2, 6–13]. However, other comparative studies have also shown that patients aged ≥ 80 years experience pain relief and improved functional outcomes equal to their younger counterparts at a follow-up of 1 year, while the rates of complications were not increased in older age groups [4, 14]. Moreover, some papers mentioned that age alone was not a factor affecting joint arthroplasty outcomes and should not be a limiting factor when identifying surgical candidates

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[15]. Considering the various results from the previous studies, it was inevitable for much clinical controversy regarding age and surgical risk to arise when considering TKA in octogenarian patients. Such controversy in results can be attributed to multiple confounders that could affect clinical outcomes after TKA and the differences among studies. Thus, there is a need to control confounders when comparing TKA outcomes between elderly and younger patients.

The evaluation of outcomes after TKA has traditionally been performed by physician-assessed objective clinical outcomes such as implant survival, revision requirement, complication rates, and radiological parameters [16, 17]. Although these clinical outcomes were important for orthopedic surgeons to evaluate TKA success, no subjective information was directly obtained from patients who experienced minor improvements in range of motion (ROM) or limb alignment within strict ranges [18]. Few studies have compared patient-reported outcomes using the propensity score matching method to control preoperative confounders that negatively influence postoperative outcomes, such as body mass index (BMI), American Society of Anaesthesiologists (ASA) score, and anesthesia type [19–21]. Here, we intended to identify differences in the objective and subjective clinical effects of TKA between octogenarian and sexagenarian patients by measuring the degree of improvement of each variable. Therefore, the aim of this study was to compare patient-reported outcomes, postoperative parameters, length of hospital stay, 90-day mortality, and objective clinical outcomes after TKA between octogenarian and sexagenarian patients using a propensity score matching analysis.

Materials and methods

The design and protocol of this retrospective case-controlled comparative study with a propensity score matching analysis were approved by our facility's institutional review board (ID-Number KUH 1060139). All patients provided consent for their medical records to be used in a scientific study. We retrospectively reviewed the medical records of elderly patients with degenerative osteoarthritis having undergone TKA (TKA) performed by a single surgeon between September 2007 and September 2016. We included only patients for whom all data elements were prospectively collected, including demographics, anesthesia type, complications, ASA grade, ICD-9 CM data for the Charlson Comorbidity Index (CCI) calculation; pre- and postoperative functional outcomes with regard to Knee Society score (KSS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores; and physical data such like ROM and degree of flexion contracture. To meet these requirements, we identified a total of 251 patients ($n = 38$ aged ≥ 80 years; 213 aged 65–70 years) who underwent TKA for the treatment of degenerative osteoarthritis. The exclusion criteria were a diagnosis of rheumatoid arthritis and the performance of simultaneous bilateral TKA or revision arthroplasty. Propensity score matching was done for BMI, preoperative ASA score, and anesthesia type in both groups. The matched variables were selected to control for potential confounders having an influence on postoperative clinical outcomes after TKA [16–18]. In the propensity score matching analysis, 38 patients aged ≥ 80 years (group 1) were matched to 41 younger patients (group 2) who met the matching criteria (Fig. 1).

In the assessment of objective clinical outcomes, KSS, ROM, and flexion contracture were measured pre- and postoperatively and the degree of improvement of each was

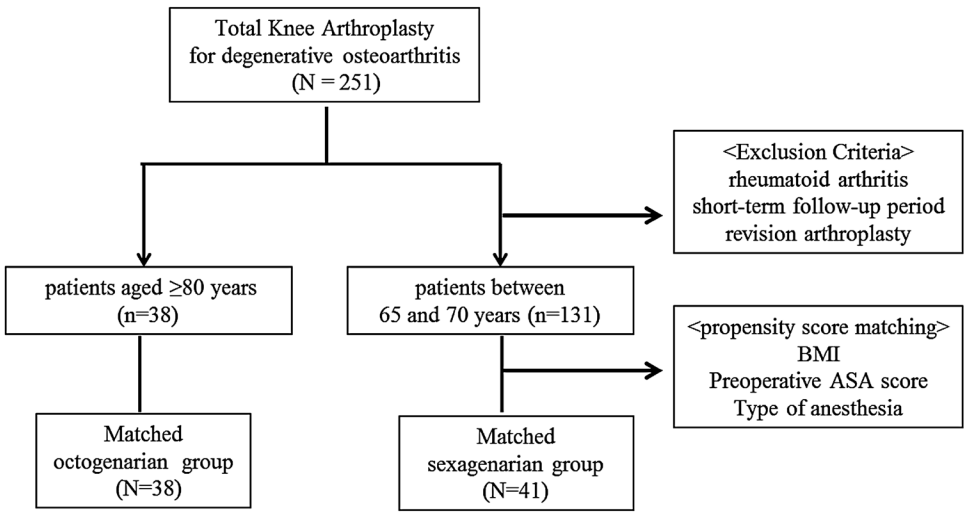

Fig. 1 Flow chart

recorded. WOMAC scores and 36-Item Short-Form Health Survey (SF-36) scores were evaluated for the assessment of subjective outcomes by the same methods. Length-of-hospital stay, 90-day mortality rate, blood transfusion volume, requirement for intensive care unit (ICU) admission, presence of delirium, and re-admission within 30 days were evaluated in the immediate postoperative period. The measured variables were compared between the two groups.

All statistical comparisons were made using Statistical Package for Social Science (SPSS) software (version 21; Chicago, IL, USA). Continuous variables (such as age; BMI; WOMAC, KSS, and SF-36 scores) were expressed as mean ± standard deviation and range. Categorical variables (such as ASA score and CCI score) are expressed as frequency and percentage. We evaluated differences in categorical variables using the Chi-square test, independent sample *t* test, or Fisher's exact test as appropriate. The level of statistical significance was set at $p < 0.05$. The normality of the variable distribution was tested by the Kolmogorov–Smirnov test.

Results

Propensity score matching allowed relevant variables to be balanced between octogenarian patients and sexagenarian patients, minimizing the effect of selection bias. Propensity matching was done for ASA scores, BMI, and anesthesia type in either group. After propensity matching, the corrected mean age was 82.8 ± 2.9 in the octogenarian patients (group 1) and 67.9 ± 1.4 in the sexagenarian patients (group 2). There was no intergroup difference in those variables. The mean follow-up period was 47.5 months (range 10–120 months) in group 1 and 54.8 months (range 6–126 months) in group 2 (Table 1).

In the preoperative comparison, group 1 had significantly inferior preoperative CCI and WOMAC scores compared to group 2 ($p < 0.001$ and $p = 0.012$, respectively). The other preoperative variables did not differ significantly between the two groups (Table 2). These results indicate that octogenarian patients had more medical comorbidities and lower preoperative subjective knee function than sexagenarian patients.

Objective knee function assessment after TKA

The clinical outcomes for objective knee function were evaluated based on ROM, flexion contracture degree, KSS, and the degree of improvement in those variables was also measured. ROM and flexion contracture degree improved after TKA in both groups, but there was no significant difference in preoperative values, postoperative values, and degree of improvement ($p = 0.381$ and $p = 0.130$, respectively). The mean pre- and postoperative KSS scores of group 1 were higher than those of group 2, but the intergroup differences were not significant ($p = 0.094$) (Table 3).

Table 1 Propensity score matched group 1 and group 2 cohort baseline comparisons

	Group 1 ($n = 38$)	Group 2 ($n = 41$)	p value[†]
Age	82.8 (2.9)	67.9 (1.4)	< 0.001
Gender (M/F) (% of women)	6/32 (84%)	3/38 (92%)	0.668
BMI (kg/m^2)	25.6 (4.1)	25.8 (3.5)	0.846
ASA score			0.645
I	0	0	
II	23 (61%)	25 (61%)	
III	13 (34%)	16 (39%)	
IV	2 (5%)	0	
Type of anesthesia			0.575
General anesthesia	29 (76%)	26 (68%)	
Spinal anesthesia	9 (24%)	12 (32%)	

ASA American Society of Anesthesiologist

[†] p values set significant < 0.05

Subjective knee function assessment after TKA

The patient-reported outcomes were evaluated based on pre- and postoperative WOMAC and SF-36 scores, and the degree of improvement in each were also measured. The postoperative WOMAC score was significantly higher in group 1 than in group 2 ($p = 0.009$), although there was no significant difference in the degree of improvement ($p = 0.192$). However, there was a statistical difference in postoperative SF-36 score and degree of improvement in favor of group 2 despite no difference in preoperative intergroup values ($p = 0.022$ and $p = 0.001$, respectively) (Table 4).

Postoperative parameters after TKA

The mean transfusion volume was significantly higher for group 1 than group 2 (3.32 versus 1.76 units, respectively) ($p = 0.004$). The mean length of hospital stay was significantly prolonged in group 1 compared to group 2 (20.9 versus 14.4 days, respectively) ($p < 0.001$). Five patients (13.1%) in group 1 versus 0 in group 2 required ICU admission. The delirium, superficial infection, and rates of re-admission within 30 days showed increasing values in group 1, but these differences were not statistically significant ($p = 0.674$, $p = 0.217$, $p = 0.200$, respectively). No patients in either group died within 90 days (Table 5).

Table 2 Comparison of preoperative parameters between group 1 and group 2

	Group 1 (SD; range)	Group 2 (SD; range)	*p* value†
CCI score, point	4.61 (0.82; 4–7)	3.05 (1.00; 2–5)	< 0.001
Range of motion (°)	118 (16.0; 80–145)	115 (23.7; 50–150)	0.642
Flexion contracture (°)	9.7 (8.3; 0–30)	8.5 (9.1; 0–30)	0.543
WOMAC score, point	50.2 (11.4; 29.5–76.4)	44.6 (7.43; 31.0–65.0)	0.012
SF-36, point	39.5 (7.46; 18.0–54.7)	39.4 (10.3; 26.3–60.9)	0.956
KSS, point	59.58 (11.18; 34–88)	59.22 (11.02; 42–83)	0.886

SD standard deviation, *CCI* Charlson's comorbidity score index, *WOMAC* Western Ontario and McMaster Universities Osteoarthritis Index, *SF-36* 36-Item Short-Form Survey, *KSS* Knee Society Score

†*p* values set significant < 0.05

Table 3 Comparison of postoperative range of motion and the degree of flexion contracture and the degree of improvement in those parameters between group 1 and group 2

	Group 1 (SD; range)	Group 2 (SD; range)	*p* value†
Range of motion (°)	140 (10.7; 110–160)	139 (12.1; 95–155)	0.75
The degree of improvement in ROM (°)	12.2 (9.0; 0–35)	15.1 (14.0; 0–60)	0.381
Flexion contracture (°)	2.6 (5.9; 0–30)	1.2 (3.1; 15–50)	0.194
The degree of improvement in flexion contracture (°)	7.1 (8.0; 0–30)	3.9 (10.3; 25–30)	0.13
KSS, point	68.34 (9.99; 47–89)	64.83 (10.36; 49–94)	0.13
The degree of improvement in KSS	8.76 (10.15; 0–50)	5.61 (5.37; 1–23)	0.094

SD standard deviation, *ROM* range of motion, *KSS* Knee Society Score

†*p* values set significant < 0.05

Table 4 Comparison of postoperative KSS, WOMAC score, SF-36, and the degree of improvement in those parameters between group 1 and group 2

	Group 1 (SD; range)	Group 2 (SD; range)	*p* value†
WOMAC score, point	28.7 (13.5; 8.3–61.4)	21.7 (8.7; 6.8–38.4)	0.009
The degree of improvement in WOMAC score	21.6 (4.6; 12–31)	23.0 (4.71; 14-33.4)	0.192
SF-36, point	51.3 (14.6; 19.9–79.2)	59.5 (16.5; 32.9–85.1)	0.022
The degree of improvement in SF-36	11.8 (10.5; 1.9–40.4)	20.1 (11.1; 3.6–42.3)	0.001

SD standard deviation, *WOMAC* Western Ontario and McMaster Universities Osteoarthritis Index, *SF-36* 36-Item Short-Form Survey

†*p* values set significant < 0.05

Table 5 Comparison of perioperative parameters and complications between group 1 and group 2

	Group 1 ($n = 38$)	Group 2 ($n = 41$)	*p* value†
Length-of-hospital stay (day)	20.9 (10.8; 7–59)	14.41 (4.88; 4–31)	< 0.001
Transfusion volume (pack)	3.32 (2.58; 0–11)	1.76 (2.07; 0–6)	0.004
Delirium, *n* (%)	4 (10.5)	2 (4.9)	0.674
Superficial infection, *n* (%)	8 (21.1)	6 (14.6)	0.217
Re-admission within 30 days, *n* (%)	5 (13.1)	2 (4.9)	0.2
ICU care, *n* (%)	5 (13.1)	0	NA
90-day mortality, *n* (%)	0	0	NA

ICU Intensive Care Unit

†*p* values set significant < 0.05

Discussion

As the active elderly population continues to grow, an increasing attention has been paid to the use of TKA to maintain a high quality of life in elderly patients with degenerative osteoarthritis. Achieving satisfactory outcomes after TKA in elderly patients is becoming an emerging burden for orthopedic surgeons. For that reason, it is important for orthopedic surgeons to assess patient satisfaction after TKA. Patient-reported outcome measures (PROMs) are gradually being accepted as an important part of postoperative outcome assessments in term of patient satisfaction [22]. Therefore, our study was designed using objective and subjective variables (PROMs) to evaluate postoperative clinical outcomes after TKA.

Because it used a propensity score matching analysis, our study was appropriate in terms of controlling confounding factors that had influence on TKA prognosis, such as BMI, ASA score, and anesthesia type [15–17]. Although some papers reported that flexion contractures also have a negative effect on postoperative outcomes after TKA, the intergroup difference in preoperative flexion contracture was already comparable in our results [23]. Although some studies used a propensity score matching analysis similar to the current study, the limitation of this study was the need to match many parameters, even comorbidities [24]. Because comorbidities originally included age, it is possible that the result could be distorted if matching included age-related factors. Thus, our study was more proper than the previous reports, since it was considered as age-related comorbidities.

Many studies reported that the clinical outcomes after TKA in elderly patients were satisfactory in terms of pain relief and functional improvement. Our results also showed that both groups had improved objective and subjective outcomes. Thus, our study results correlate with those of previous similar studies. Although some papers reported low functional outcomes in patients aged ≥ 80 years or older after TKA, later on, many articles reported no differences according to age [2, 8–12, 15]. In our study, KSS score, ROM, and flexion contracture degree were evaluated in the assessment of objective knee function and patient-reported outcomes, while WOMAC and SF-36 scores were also measured for the evaluation of subjective knee function. There was no difference in ROM, KSS score, or flexion contracture degree pre- or postoperatively. The mean improvement of objective knee function in our results was comparable to that reported in previous studies. These results indicate that the clinical effect of TKA in terms of objective improvement was similar regardless of age.

Various articles mentioned no difference in health-related quality of life after TKA between elderly patients and their younger counterparts. Unlike previous reported results, our study showed that although postoperative SF-36 and WOMAC scores improved in both groups, there were significant differences in postoperative values between the two groups. The degree of improvement in SF-36 was measured with significantly lower levels in group 1. These results mean that, although the clinical effect of TKA was excellent in terms of improvement in objective knee function in the octogenarian population, those patients receiving TKA had inferior outcomes with regard to subjective satisfaction of quality of life compared with their younger counterparts. Therefore, TKA would be beneficial to octogenarian patients in respect of the advancement of objective functions but did not seem to arouse sufficient satisfaction on quality of life.

As expected with regard to postoperative parameters, group 1 was associated with a significantly longer mean hospital stay and higher transfusion requirement, leading to a high financial burden. The low SF-36 scores of octogenarian patients may be attributed to high economic burden derived from both longer hospital stays and re-admission, because the mean SF-36 score of our study reflects the psychosocial impact of TKA on patients.

Although not statistically significant, postoperative delirium, superficial infection, re-admission within 30 days, and the requirement for ICU care were also higher in group 1 than group 2. However, there were no cases of 90-day mortality in either group. Other articles questioned the wisdom of performing elective surgery in octogenarian patients because of their presumed susceptibility to major complications [8, 9]. Although many studies mentioned that patients aged ≥ 80 years had higher complication and mortality rates after TKA, our findings did not show a higher complication rate in older patients, comparable to other previous reports [2, 4, 8–12, 14, 25]. Thus, the concern about high complication and mortality rates in the octogenarian population was no longer a matter of discussion with respect to appropriate patient selection for TKA.

Our study showed favorable outcomes in octogenarian patients with respect to the magnitude of change in both objective and subjective outcomes associated with a perceived improvement in quality of life. The possible reason for this was that appropriate patient selection was performed in octogenarian patients through preoperative interviews during the preoperative evaluation visit, which contributes to the achievement of favorable outcomes in those patients who underwent TKA. Thus, the orthopedic surgeon had to perform TKA in carefully selected octogenarian patients and determine each patient's expectations and needs for surgery through preoperative interviews, which could lead to TKA success.

The retrospective nature of our study's design is one of its limitations, but we tried to overcome the associated selection

bias using propensity score matching, which makes study groups more uniform, and including consecutive cases operated on by a single surgeon, thus making our results more applicable to real practice. Besides, our emphasis was on establishing the safety profile of octogenarian compared to sexagenarian patients in terms of subjective satisfaction.

Conclusion

Although the objective functional outcomes in group 1 were comparable to those in group 2, there were significant intergroup differences in patient-reported outcomes, specifically WOMAC and SF-36 scores. Moreover, the degree of improvement in SF-36 was significantly lower in group 1 than in group 2. These findings mean that although the functional improvement of TKA was excellent regardless of age, TKA seemed to contribute little to quality of life in octogenarian patients. Therefore, octogenarian patients require moral support after TKA to achieve subjective satisfaction in quality of life.

Compliance with Ethical standards

Conflict of interest The authors declare no conflict of interest in relation to the preparation of current study.

Ethical approval The design and protocol of this retrospective case-controlled comparative study with a propensity score matching analysis were approved by our facility's institutional review board (ID-Number KUH 1060139).

Informed consent All patients provided consent for their medical records to be used in a scientific study.

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