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Quality of life after staged bilateral total knee arthroplasty: a minimum five-year follow-up study of seventy-eight patients

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Abstract

Purpose Although many studies have been performed to evaluate the quality of life (QOL) and patient satisfaction after total knee arthroplasty (TKA), almost all evaluations were performed in patients after unilateral TKA or in patients after mixed unilateral and bilateral TKA. Accordingly, this study aimed to evaluate QOL after staged bilateral TKA.

Methods A total of 78 patients who underwent staged bilateral TKA for varus knee osteoarthritis were included in this study. All patients had longitudinal follow-up evaluations for at least five years. QOL was assessed by the Japanese Knee Osteoarthritis Measure (JKOM), a disease-specific and patient-derived QOL measure for Japanese patients. Conventional objective outcome scales, including the Knee Society Score and the Timed Up and Go test, were also assessed. In addition, QOL and objective outcomes were compared between the younger (≤ 80 years, average 75.8 years) and older (> 80 years, average 84.7 years) age groups at the final follow-up.

Results Improvements in both JKOM and objective outcomes reached a plateau one year after staged bilateral TKA. Improvements were prolonged for more than five years. There were no statistically significant differences in JKOM or objective outcomes between the younger and older age groups, despite an 8.9-year difference in the average age.

Conclusions This was the first longitudinal study to evaluate QOL and objective outcomes after staged bilateral TKA for a period of at least five years. Improvements in QOL and objective outcomes reached a plateau one year after staged bilateral TKA and were prolonged for more than five years. No significant differences were observed in outcome scores between the younger and older age groups.

Keywords Total knee arthroplasty · Osteoarthritis · Quality of life · Longitudinal evaluation · Japanese Knee Osteoarthritis Measure

Introduction

Clinical outcomes after total knee arthroplasty (TKA) are assessed not only by objective or physician-driven criteria, such as the Knee Society Score (KSS) [1], the Timed Up and Go test (TUG) [2], and range of motion of the knee, but also by subjective or patient self-reported outcome scales such as the Western Ontario and McMaster University Osteoarthritis Index

(WOMAC) [3] and the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) [4]. Some researchers have argued that subjective scales are more suitable than objective ones for examining TKA outcomes [5–8]. Although many longitudinal assessments of subjective outcomes have been reported [9–23], most were performed in patients after unilateral TKA or in mixed patients after unilateral and bilateral TKA. To the best of our knowledge, only one longitudinal subjective outcome assessment after staged bilateral TKA has been reported [14]. This previous study evaluated the quality of life (QOL) of Japanese patients after staged bilateral TKA for three years using a disease-specific and patient-derived QOL measure, the Japanese Knee Osteoarthritis Measure (JKOM), for Japanese patients with osteoarthritis [24]. The results indicated that improvements in both JKOM and objective outcomes reached a plateau one year after staged bilateral TKA and were maintained for at least two years thereafter.

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Midterm clinical outcomes after simultaneous or staged bilateral TKA have never been reported. Because the QOL of older patients is expected to worsen with the natural aging process, the next issues we have to clarify are how long the improvements in both JKOM and objective outcomes will be maintained and whether the improvements will vary depending on the patient's age at final follow-up. Therefore, the purpose of the current study was to longitudinally evaluate QOL using JKOM and objective outcomes using KSS and TUG in patients who had undergone staged bilateral TKA for varus knee osteoarthritis and had received follow-up examinations for more than five years. In addition, this study aimed to identify whether there were any differences in subjective and objective assessment scores between younger (≤ 80 years) and older (> 80 years) age groups at their final follow-up.

Materials and methods

The study protocol was approved by the Institutional Review Board of the Tohoku Orthopaedic Clinic. Written informed consent for the use of data in the study was obtained from all patients.

A total of 78 patients who underwent staged bilateral TKA for varus knee osteoarthritis in our clinic between October 2006 and March 2013 were included in the study. All of these TKAs were performed by the same surgical team using the NexGen® TKA system (Zimmer; Warsaw, IN, USA). The patients were evaluated pre-operatively (pre-TKA) and at one, three and 5 years or more after staged bilateral TKA (average 6.7 years, range 5–10 years) by JKOM, KSS, and TUG. There were 11 male and 67 female patients. The average patient age was 73.3 years (range 61–85 years) at the time of the first TKA and 74.0 years (range 62–85 years) at the time of the contralateral TKA. The average time interval between the first and contralateral TKA was 9.2 months (range 4–29 months). The patients were divided into two groups based on their age at the final follow-up: ≤ 80 years (younger group) and > 80 years (older group). The younger group had 36 patients with an average age of 75.8 years (range 67–80 years), while the older group had 42 patients with an average age of 84.7 years (range 81–92 years). The JKOM consists of four subscales (25 items in total): pain and stiffness in the knees (8 items), conditions of daily life (10 items), general activities (5 items), and health conditions (2 items) (Table 1). Each item is scored from 0 (best quality) to 4 (worst quality), resulting in a total score between 0 and 100, with lower scores indicating better QOL.

In the statistical analysis, the outcomes at each evaluation point were compared using the Friedman and Steel–Dwass tests. Comparisons of JKOM and objective outcomes between the younger and older age groups were performed using the

Table 1 The content of the Japanese Knee Osteoarthritis Measure (JKOM)

I. Degree of knee pain (pain VAS)

II. Pain and stiffness in knees

Here are a couple of questions regarding your knee function during the last few days. Choose one answer and mark an X in the box next to it. [Options: Not at all, slight, moderate, quite, extreme]

1. Do you feel stiffness in your knees when you wake up in the morning?

2. Do you feel pain in your knees when you wake up in the morning?

3. How often do you wake up in the night because of pain in your knees?

4. Do you have pain in your knees when you walk on a flat surface?

5. Do you have pain in your knees when ascending stairs?

6. Do you have pain in your knees when descending stairs?

7. Do you have pain in your knees when bending to the floor or standing up?

8. Do you have pain in your knees when standing?

III. Condition in daily life

Here are a couple of questions regarding your ability to perform daily routines during the last few days. Choose one answer and mark an X in the box next to it. [Options: Not at all, a little, moderately, quite, extremely]

9. How difficult is ascending or descending stairs?

10. How difficult is bending to the floor or standing up?

11. How difficult is standing up from sitting on a western style toilet?

12. How difficult is wearing pants, skirt, and underwear?

13. How difficult is putting on socks?

14. How long can you walk on a flat surface without taking a rest? [More than 30 min, about 15 min, around my house, can hardly walk]

15. Have you been using a walking stick (cane) recently? [Not at all, hardly, sometimes, often, always]

16. How difficult is shopping for daily necessities? [Not at all, a little, moderately, quite, extremely]

17. How difficult is doing light housework (cleaning the dining room after eating, etc.)? [Not at all, a little, moderately, quite, extremely]

18. How difficult is doing heavy housework (using the vacuum cleaner, etc.)? [Not at all, a little, moderately, quite, extremely]

IV. General activities

Here are a couple of questions regarding your general activities during the last one month. Choose one answer and mark an X in the box next to it.

19. Have you gone to an event or to department store during the last one month? [More than 2-3 times a week, about once a week, about every 2 weeks, once a month, not at all]

20. Were things that you usually do (some kind of lesson, meeting friends, etc.) difficult because of knee pain during the last one month? [Not at all, a little, moderately, quite, extremely]

21. Did you limit doing things you usually do because of knee pain during the last one month? [Not at all, a little, moderately, quite, didn't do them (things you do usually) at all]

22. Did you despair of going outside somewhere close because of knee pain during the last one month? [Not at all, hardly, sometimes, often, didn't go outside (close)]

23. Did you despair of going outside somewhere far because of knee pain during the last one month? [Not at all, hardly, sometimes, often, didn't go outside (far)]

V. Health conditions

Here are a couple of questions regarding your health during the last one month. Choose one answer and mark an X in the box next to it.

Table 1 (continued)

24. Do you think your health during the last one month is average? [I really think so, I think so, I don't know, I don't think so, I don't think so at all]
25. Do you think that knee pain has been affecting your health badly during the last one month? [It isn't affecting it at all, It is affecting it a little, It is affecting it moderately, It is affecting it significantly, It is affecting it greatly]

Mann–Whitney U test, with p values < 0.05 indicating statistical significance.

Results

None of the patients in the sample required revision TKA. The JKOM scores significantly improved between pre-TKA and 1 year after staged bilateral TKA ($p < 0.01$). The improvement was maintained until the final follow-up (Fig. 1a). All four subscales of the JKOM showed the same improvement as the JKOM itself (Fig. 1b). KSS total score, knee score, and
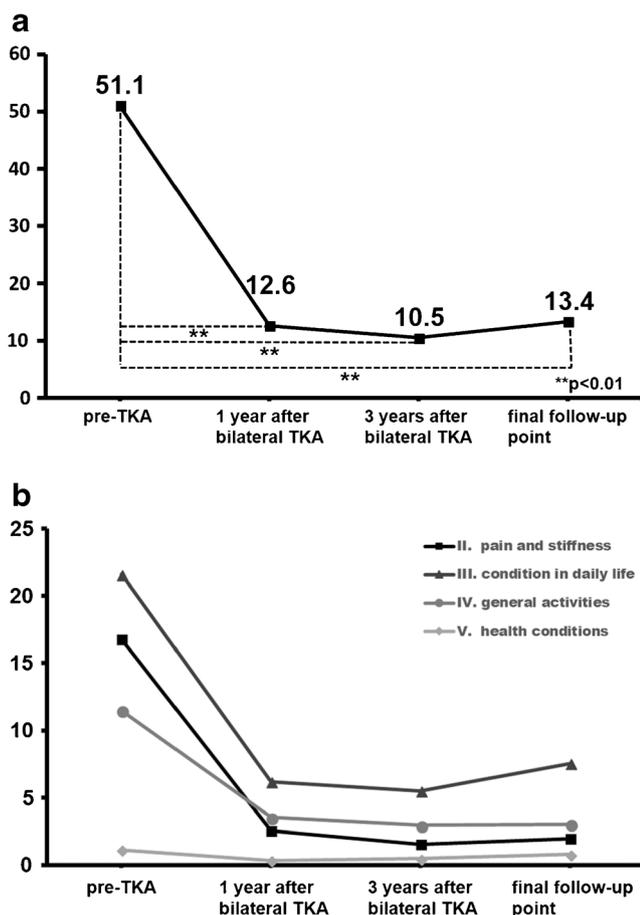
Fig. 1 Japanese Knee Osteoarthritis Measure (JKOM) scores significantly improved between pre-total knee arthroplasty (TKA) and 1 year after staged bilateral TKA ($p < 0.01$). The improvement at 1 year after staged bilateral TKA was prolonged for more than 4 years (**a**). Each subscale of the JKOM showed similar changes (**b**)

function score also significantly improved between pre-TKA and one year after staged bilateral TKA ($p < 0.01$). The improvements were maintained until the final follow-up (Fig. 2). TUG also significantly improved between pre-TKA and one year after staged bilateral TKA ($p < 0.01$). Although the improvement was maintained for three years, there was a small but statistically significant deterioration at the final follow-up ($p < 0.05$) (Fig. 3). There were no statistically significant differences in JKOM and objective outcome scores between the younger and older age groups, in spite of the average age difference of 8.9 years between the two groups (Table 2).

Discussion

The most important findings of the present study were as follows: JKOM, KSS, and TUG scores showed statistically significant improvements between pre-TKA and one year after staged bilateral TKA. These improvements reached a plateau one year after staged bilateral TKA and were prolonged for more than five years. In addition, the improvements in JKOM and objective outcome scores in the older age group (84.7 years on average) showed no significant difference from those of the younger age group (75.8 years on average) at final follow-up.

Several longitudinal subjective outcome assessments [9–23] of patients undergoing TKA have been performed. Lozano-Calderon et al. [10] evaluated 412 patients with 441 cruciate-retaining TKAs and 328 patients with 403 posterior-substituting TKAs pre-operatively and at six weeks, three months, one year, and two years for pain, motion, and function. They concluded that both types of TKA could be used with satisfactory outcomes. Gandhi et al. [11] reported that WOMAC and SF-36 scores were relatively constant three to four years after 551 unilateral TKAs for osteoarthritis and then gradually declined. Pivec et al. [15] assessed patient satisfaction
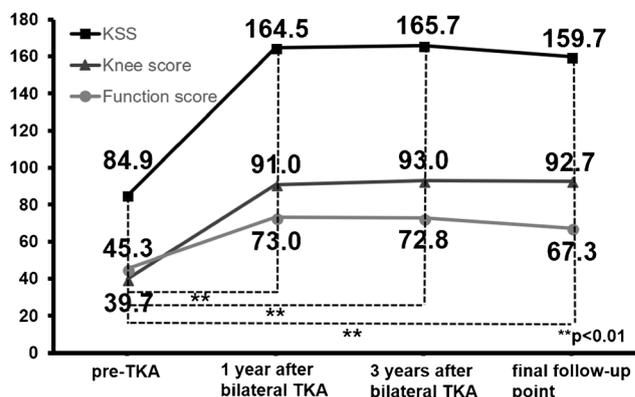
Fig. 2 Knee Society Score (KSS) significantly improved between pre-total knee arthroplasty (TKA) and 1 year after staged bilateral TKA ($p < 0.01$). The improvement at 1 year after staged bilateral TKA was prolonged for more than 4 years
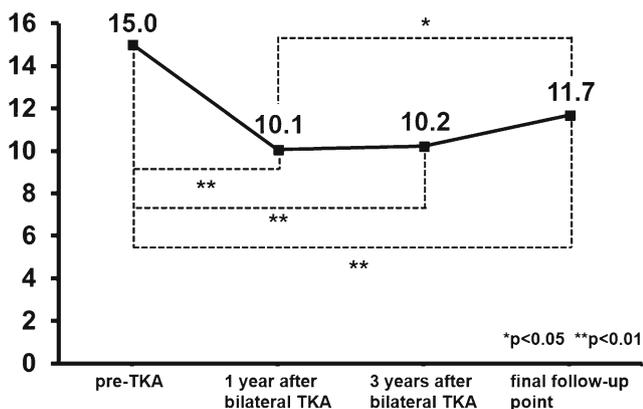
Fig. 3 Timed Up and Go test (TUG) score significantly improved between pre-total knee arthroplasty (TKA) and 1 year after staged bilateral TKA ($p < 0.01$). Although the improvement was maintained for 3 years, there was a small but statistically significant deterioration at the final follow-up ($p < 0.05$)

following 287 TKAs in 281 patients by a SF-36 survey and concluded that both physical and mental scores plateaued at one year. Thus, almost all evaluations were performed in patients after unilateral TKA or in mixed patients after unilateral and bilateral TKA; however, knee osteoarthritis generally occurs bilaterally. Kahn et al. [25] examined the WOMAC scores of 171 patients who underwent unilateral TKA and concluded that the level of osteoarthritic symptoms in the contralateral knee at the time of TKA was associated with poorer post-operative outcomes in the operated knee. Therefore, evaluation of QOL after bilateral TKA should be more suitable than evaluation after unilateral TKA to assess the actual benefits of TKA for osteoarthritic knees. To the best of our knowledge, a study from our institution has been the only report of longitudinal subjective outcome assessment after staged bilateral TKA [14]. We concluded that improvements in both JKOM and objective outcomes reached a plateau one year after staged bilateral TKA and were maintained for at least three years [14]. The current study performed follow-up evaluations for five years or more (average 6.7 years, range 5–10 years) to determine the duration

of prolonged improvements in both JKOM and objective outcomes after staged bilateral TKA and found that the improvements were maintained for more than five years.

With regard to patient satisfaction or improvement in QOL after TKA, Kwon et al. [8] found that absolute post-operative subjective scores were more highly correlated with patient satisfaction than were improvements between pre-operative and post-operative scores and warned that delayed surgical intervention for advanced osteoarthritis could have adverse effects on patient satisfaction. Kahn et al. [25] suggested that for those patients with more symptomatic contralateral knees, the best option might be simultaneous or closely staged bilateral TKAs. Our previous study showed that JKOM, KSS, and TUG scores showed statistically significant improvements between post-unilateral TKA and one year post-staged bilateral TKA [14]. The improvements reached a plateau one year after staged bilateral TKA and were prolonged for more than five years in the current study. Therefore, we also recommend performing contralateral TKA shortly after unilateral TKA or simultaneous bilateral TKAs to maximize patients' QOL.

Recently, the importance of healthy aging has been recognized worldwide. According to Davinelli et al. [26], the estimated proportion of people older than 60 years will rise from 20% to almost 40% in some European countries by 2050. In the USA, Blagosklonny [27] forecasts that the Social Security Trust Fund will be exhausted in 2033 and Medicare's hospital insurance trust fund will be depleted by 2024. It is therefore expected in the orthopaedic field that osteoarthritis will increase to cause deterioration in healthy aging in the future. The number of US adults with doctor-diagnosed arthritis, the majority of which is related to osteoarthritis, is projected to increase to nearly 67 million by 2030, based upon National Health Interview Survey data [28]. In 1994, knee osteoarthritis was recognized as the leading cause of mobility impairment in older adults [29]. It is imperative to emphasize research on knee osteoarthritis to reduce the frailty and disability associated with it and maintain healthy aging. The present study revealed that improvements in both QOL and objective

Table 2 Comparison of JKOM, KSS, and TUG scores between younger (≤ 80 years of age) and older (> 80 years) patients

	Younger age group ($n = 36$)	Older age group ($n = 42$)	p value
JKOM	11.6 ± 11.0	14.9 ± 13.3	0.23
Pain and stiffness in knees	1.8 ± 2.6	2.1 ± 3.7	0.92
Condition in daily life	6.5 ± 6.8	8.4 ± 7.7	0.33
General activities	2.5 ± 2.2	3.5 ± 3.5	0.44
Health conditions	0.7 ± 1.5	0.9 ± 1.7	0.66
KSS	164.4 ± 24.1	155.7 ± 27.7	0.13
Knee score	93.2 ± 8.9	92.3 ± 10.7	0.72
Function score	71.3 ± 18.3	63.9 ± 23.1	0.17
TUG	11.1 ± 3.5	12.2 ± 3.7	0.15

Values are expressed as average ± standard deviation

outcomes were prolonged for more than five years after staged bilateral TKA for osteoarthritic knees, and that there were no significant differences in JKOM and objective outcome scores between younger (≤ 80 years) and older (> 80 years) patients, despite an 8.9-year difference in average age at the final follow-up. These facts indicate that TKA is one of the most effective methods of achieving good QOL and healthier aging, even among older people with severely osteoarthritic knees.

This study had several limitations. First, it included only a small number of patients, and the follow-up rate was relatively low. This could be due to the fact that we only included patients who underwent staged bilateral TKA for varus knee osteoarthritis using the same TKA system and for whom evaluation data for more than five years were available. Second, the follow-up period was only up to ten years. Further long-term investigations are required to determine the duration of QOL maintenance after bilateral TKA, particularly because the QOL in older patients is expected to worsen with age. Third, the optimal time interval between the first and contralateral TKA could not be determined; however, we generally set it as ≥ six months considering the general condition of older patients. Although the average time interval was 9.2 months (range 4–29 months), it was ≥ 12 months in nine patients. Contralateral TKA had to be delayed in these nine patients because of various reasons, including general condition (e.g., slight cerebral infarction or ischaemic heart disease) and family circumstances (e.g., spouse's death or son's job transfer). Because we did not consider the maximum delay of 29 months as long in this midterm follow-up study, these nine patients were included. Finally, only Japanese patients were evaluated in this study, which used the JKOM, a measure developed for Japanese patients with Japanese lifestyles. However, the conclusions of this study could be generalized to other ethnicities since the JKOM is based on a slight modification of the WOMAC, which has been utilized worldwide.

Conclusion

This is the first longitudinal midterm follow-up study that evaluated QOL after staged bilateral TKA. JKOM and objective outcome scores reached a plateau one year after staged bilateral TKA. The improvement was maintained for 6.7 years on average, except for TUG, which showed a slight deterioration at the final follow-up. The older age group maintained equivalent improvements in JKOM and objective outcome scores to those of the younger age group. TKA should be considered an effective method to achieve good QOL and healthier aging, even among older patients.

Compliance with ethical standards

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