

Clinical and Functional Outcomes of Primary Total Knee Arthroplasty in the Elderly: A retrospective, Single Center, Real-World Study

Nan Jiang

920th Hospital of Joint Logistics Support Force, Yunnan

Xiaoyan Zhang

921th Hospital of Joint Logistics Support Force, Yunnan

Yipeng Wu

922th Hospital of Joint Logistics Support Force, Yunnan

Yi Wang (✉ yi_wang2020@yahoo.com)

922th Hospital of Joint Logistics Support Force, Yunnan

Research Article

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Abstract

Background:

The current study aimed to identify the effectiveness of TKA in improving functional outcomes in a predominantly elderly patient cohort.

Methods:

Data were collected retrospectively from the patients admitted to a specialist orthopedic center from January 2018 to December 2019. a. Demographic and clinicopathological data and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores at admission were acquired and entered as continuous variables to assess the outcomes in regression models values lesser than 0.05 was considered significant. Data analysis by univariate regression and Wilcoxon signed-rank test was implemented by R software (ver. 3.6.3)

Results: Mean duration of operation was 90.3 ± 29.08 minutes. Intraoperative blood loss was 91.9 ± 26.5 ml for females and 88.6 ± 19.1 ml for males. Mean duration of surgery was 90.3 ± 29.08 minutes (90.19 ± 23.19 in patients aged ≥ 65 years). The mean blood loss was 334.55 ± 114.28 mL (349.26 ± 107.43 mL in patients aged ≥ 65 years). Pain, function and stiffness outcome scores decreased significantly after TKA. Post-surgery, inpatient rehabilitation was attempted by 13.89%, whilst 88.88% of individuals attempted recuperation at home. Preexisting comorbidities like diabetes mellitus was present in 11.11% individuals whilst hypertension was present in 16.67% patients. Radiographic grading revealed 5% of patients with Grade 1 Kellgren Lawrence (K-L) classification, whilst 95% of patients demonstrated Grade 4 classification.

Conclusion: Understanding the underlying factors that govern TKA patients' functional restoration of mobility may reduce the length of stay. In this aspect, TKA is a viable option for improving functional outcomes even in elderly patients.

Background

Osteoarthritis (OA) is a degenerative, musculoskeletal disease that affects mobility in the fourth decade of life[1]. The mobility is most affected in the hip and knee joints [1]. OA affects more than 100 million people throughout the world, and it is one of the leading cause of years lived with disability (YLDs) [2]. It also leads to decreased activity in the elderly population[2]. OA is strongly associated with ageing and is a significant predictor for a country's overall health outcome as the demographic data shows that the Asian region is ageing rapidly[3].

Total knee arthroplasty (TKA) is the most effective surgical intervention to alleviate pain and to improve functional status in patients with OA[4]. Owing to the increase in the number of patients with OA, the number of patients opting for TKA is also reported to be increasing worldwide[5]. Despite technical

improvements, a sub-population of patients reported inferior functional outcomes after TKA [5]. Hence, it is imperative for surgeons to understand the patient and surgery related factors that could be assessed for predicting favorable post-surgical outcomes and if necessary, to modify the protocol for post-surgical care [6]. The functional improvement after TKA could be best assessed by patient-reported outcome measures (PROMs) [7]. Diverse PROMs have been previously reported to assess functional outcomes after TKA [8, 9]. However, the follow-up duration was relatively less in most of these studies[10] and the effect of different patient- and surgery-related factors were not analyzed. The discordance in pain and functional indexes were also highlighted by previous studies[11]. Only a few recent studies have reported the outcome of TKA measured with patient-reported outcome measures (PROMs) in younger patients[12]. Furthermore, patient activity was not assessed with a specific activity score in any of these studies¹². All of them reported an overall positive effect of TKA on symptoms, daily living activities (ADL), and quality of life (QoL)¹². However, a variable proportion of patients (11–25%) were dissatisfied with the outcome of their surgery[13].

Although randomized controlled trials (RCTs) provide the best effect estimates of surgical interventions, it may not be ethically and practically possible. Hence, observational studies could be used for clinical decision making[14]. Further, in China, a majority of the patients do not have access to radiographic imaging, especially among elderly population which further limits the assessment for healthcare interventions[15]. Also, diagnosis of OA requires a comprehensive approach combining multiple clinical and laboratory modalities [16]. This affects the affordability of quality healthcare among the general population [17]. Owing to the change in global demographics, the number of elderly patients with OA is increasing globally and in China [18, 19]. In China, a recent survey suggested an increase in the number of patients with OA from 26.1 million in 1990 to 61.2 million in 2017 with a significant increase in elderly patients [20].

At present, there are no well-defined protocols to guide clinicians on the management of patients after TKA in China. Additionally, the data on the outcome measures related to physical function and quality of life in pre-operative and post-operative settings is scarce. There is an unmet need to assess these outcomes' implications to strategize pain management in the vulnerable elderly population effectively. In this context, our study aimed to assess the real-world effectiveness of contemporary knee arthroplasty in patients aged 55 years or above and evaluate the post-operative functional outcomes and the pre-operative factors predicting functional outcomes in patients undergoing TKA. To achieve this goal, we conducted a retrospective observational study with a follow-up duration of 1-year. This study report outcomes measured using PROM to assess the outcomes of TKA on physical activity, pain, and satisfaction.

Methods

A retrospective single center cohort study was conducted amongst elderly patients who underwent TKA for knee osteoarthritis at a specialist orthopedic hospital in China. The study assessed the functional mobility and improvement in pain indexes during a period of 12 months (January 2018 to February 2019)

following a rehabilitation protocol established by specialists. Patients diagnosed with primary osteoarthritis and subsequently underwent TKA by specialist surgeons were included in the study.. The exclusion criteria were as follows: (1) rheumatoid arthritis or other inflammatory diseases; (2) unwilling to provide informed consent; (3) physical, mental, or neurological conditions that could compromise the patient's ability and compliance with post-operative rehabilitation and follow-up (e.g., drug or alcohol abuse, severe mental illness, and general neurological conditions such as Parkinson's disease and multiple sclerosis); and (4) known sensitivity to materials in the devices.

Following surgery, the patients were discharged after a thorough assessment of the functional mobility indices such as the free movement for a short distance (from bed to a chair) and improved ability to climb upstairs with aid (crutches or personal care).

Follow up care included post-operative rehabilitation initiated post three days after TKA. The standardized protocol included one hour of stretching exercises to improve knee flexibility and extension in an open kinetic chain mode, straight leg raise exercises without any weights. Subsequently, the patients underwent advanced exercises like single leg squats, crossover walk to improve balance and proprioception. Additionally, the patients were advised to engage in activities that improved joint stability like using weights whilst walking or climbing stairs or on an hour of continuous passive motion (CPM). All the rehabilitation exercised were done under a face-to-face supervision of a qualified physiotherapist. Besides, adequate counselling was provided to patients regarding general health care, and specific instructions were meted out to increase their awareness of safe mobility in everyday life.

All operations were performed by senior orthopedic surgeons with more than 20 years of experience, and all patients were treated with the same routine post-operative rehabilitation and pain management protocol.

The study was approved by the institutional ethical committee of the Hospital of Joint Logistic Support, Yunnan, China.

(No.

HJLS-2546) and has been performed in accordance with the ethical standards laid down according to the Declaration of Helsinki.

Data collection and outcomes

Demographic, clinical data of the patients were acquired; additionally, anthropometric measurements of the muscles and bone were recorded. Detailed clinical examination of the patients was undertaken to emphasize any other previous prosthesis of either hip or contralateral knee. The comorbidities were recorded, and data were adjusted for confounding factors using the Charlson Comorbidity Index (CCI) [21]. Detailed mental health assessment was undertaken, and depressive disorders were graded based on the clinical diagnosis or usage of antidepressant drugs. Further, all patients included in this analysis underwent functional analysis of their mobility at admission and after discharge using Western Ontario and McMaster Universities (WOMAC) scores for OA.

[22]. The WOMAC index is the best validated and most widely used outcome measure in subjects with knee osteoarthritis. It consists of a 24-item questionnaire with questions relevant to pain, stiffness, and functional limitation. Each item offers 5 responses: "none" scored as 0, "mild" as 1, "moderate" as 2, "severe" as 3, and "extreme" as 4. Each subscale's total score is the sum of scores for each response to each item, and can be calculated manually or using a computer. The range for possible subscale scores is pain (0–20; 5 items each scored 0–4), stiffness (2 items, 0–8), and physical function (17 items, 0–68) [22].

Statistical analysis

Data were presented as median with quartiles (Q1 to Q3) or as mean with standard deviation (SD). The Wilcoxon signed-rank test and paired t-test were used for paired data for comparing pre-operative and post-operative values. The differences in distributions in the two measured time points were calculated with the Friedman test. A p-value of less than 0.05 was considered statistically significant. Continuous variables like age, BMI, comorbidities (CCI and depressive disorders), previous other joint replacements, pre-surgical hemoglobin value and WOMAC scores at admission were assessed for correlation using regression models. The dependent variables in the regression outcomes were post-operative functional scores, inpatient rehabilitation status, and blood transfusion. The cut-off values for normal hemoglobin levels were kept at 8g/dl or 9g/dl if the patient had preexisting cardiovascular disease. Our study implemented gender-specific data analysis. Data were analyzed using the R software (ver 4.0.3).

Results

Clinical and Demographic characteristics

A total of 36 patients who underwent TKA in a single hospital from 2018 to 2019 were included in the study. The number of males and females were equal in the study (n = 18). The patients' mean age was 72.08 ± 11.22 [Interquartile range (IQR), 55–88]. Except for 7 patients, all the other patients were aged > 65 years (predominantly elderly). The mean duration of the total time for surgery was 90.3 ± 29.08 minutes (90.19 ± 23.19 in patients aged ≥ 65 years). The mean blood loss was 334.55 ± 114.28 mL (349.26 ± 107.43 mL in patients aged ≥ 65 years). Intraoperative blood loss was 91.9 ± 26.5 ml for females and 88.6 ± 19.1 ml for males. Average BMI was 26.2 ± 3.4 kg/m². There were no significant differences in the baseline characteristics between males and females. In brief, females had a higher percentage of the right knee being replaced as compared to males. Further, total knee replacement surgery was performed in 16.67% individuals, with a greater number of males attempting the surgery. Uncompartmentalized knee replacement was carried out in 5.56% (n = 2) individuals. 97.22% patients had hybrid fixation as compared to 2.71% of patients undergoing cemented fixation arthroplasty. Post-surgery, inpatient rehabilitation was opted by 13.89%, whilst recuperation at home was opted by 88.88% individuals.

Preexisting comorbidities like diabetes mellitus was present in 11.11% individuals whilst hypertension was present in 16.67% patients. Mental disorders like Parkinson's disease, Alzheimer's and depressive disorders were present in majority of the individuals with 97.22%, 97.22% and 100% patients (Table 1).

Table 1
Demographic and clinical characteristics

Variable	Category	Total (%)	Female (%)	Male (%)	<i>P value</i>
Sex	Female	18 (50)			
	Male	18 (50)			
Residence	Rural	36 (100)	18 (100)	18 (100)	
Knee Joint being replaced	Left	17 (47.22)	8 (44.44)	9 (50)	<i>0.999</i>
	Right	19 (52.78)	10 (55.56)	9 (50)	
Previous Knee operation	No	32 (88.89)	16 (88.89)	16 (88.89)	<i>0.999</i>
	Yes	4 (11.11)	2 (11.11)	2 (11.11)	
Osteoarthritis	No	33 (91.67)	15 (83.33)	18 (100)	<i>0.228</i>
	Yes	3 (8.33)	3 (16.67)	0 (0)	
Rheumatoid arthritis	No	18 (50)	6 (33.33)	12 (66.67)	<i>0.09</i>
	Yes	18 (50)	12 (66.67)	6 (33.33)	
Total Knee Replacement	No	30 (83.33)	16 (88.89)	14 (77.78)	<i>0.658</i>
	Yes	6 (16.67)	2 (11.11)	4 (22.22)	
Uncompartmentalized knee	No	34 (94.44)	16 (88.89)	18 (100)	<i>0.585</i>
	Yes	2 (5.56)	2 (11.11)	0 (0)	
General anesthetic	Yes	36 (100)	18 (100)	18 (100)	
Cement	No	35 (97.22)	18 (100)	17 (94.44)	<i>0.999</i>
	Yes	1 (2.78)	0 (0)	1 (5.56)	
Hybrid	No	1 (2.78)	0 (0)	1 (5.56)	<i>0.99</i>
	Yes	35 (97.22)	18 (100)	17 (94.44)	
Home	No	4 (11.11)	2 (11.11)	2 (11.11)	<i>0.99</i>
	Yes	32 (88.89)	16 (88.89)	16 (88.89)	
Inpatient rehabilitation	No	31 (86.11)	16 (88.89)	15 (83.33)	<i>0.999</i>
	Yes	5 (13.89)	2 (11.11)	3 (16.67)	
Hypothyroidism	No	34 (94.44)	17 (94.44)	17 (94.44)	<i>0.999</i>
	Yes	2 (5.56)	1 (5.56)	1 (5.56)	
Diabetes mellitus	No	31 (86.11)	17 (94.44)	14 (77.78)	<i>0.34</i>

Variable	Category	Total (%)	Female (%)	Male (%)	<i>P value</i>
	Yes	4 (11.11)	1 (5.56)	3 (16.67)	
	NA's	1 (2.78)		1 (5.56)	
Hypertension	No	30 (83.33)	15 (83.33)	15 (83.33)	<i>0.99</i>
	Yes	6 (16.67)	3 (16.67)	3 (16.67)	
Parkinson disease	No	1 (2.78)	0 (0)	1 (5.56)	<i>0.999</i>
	Yes	35 (97.22)	18 (100)	17 (94.44)	
Alzheimer	No	1 (2.78)	0 (0)	1 (5.56)	<i>0.999</i>
	Yes	35 (97.22)	18 (100)	17 (94.44)	
Depressive disorders	No	36 (100)	18 (100)	18 (100)	

Pre-operative functional scores

Within the 36 patients assessed, flexion deformity on the pre-operative knee motion ranged from 107 to 78 degrees as determined by regression tree analysis. Radiographic grading yielded 5% with Grade 1 Kallgren Lawrence (K-L) classification, whilst 95% knees demonstrated Grade 4 classification. Based on WOMAC subscale index, median pain score was 18 (IQR: 2), median stiffness score was 7 (IQR: 1) and median function score was 61 (IQR: 2.25).

Post-operative clinical and functional scores

Wilcoxon signed rank test applied to assess relationship between pre-operative and post-operative functional scores reveal pain, function and stiffness indexes improved significantly after surgery. ($P < 0.001$) (Table 2). Evaluation of effects of preexisting co morbidities like diabetes and depressive disorders shows no significant correlation on inpatient rehabilitation outcomes (Table 3). Univariate logistic regression analysis for predictor affecting post-operative inpatient rehabilitation showed no significant results (Table 3).

Table 2
Wilcoxon Signed Rank Test of patient undergoing Total Knee Arthroplasty

	N	Pre-operative		Post-operative		<i>P-value</i>
		Median (Q1- Q3)	Range (Min- Max)	Median (Q1- Q3)	Range (Min- Max)	
Pain	36	18 (17,19)	(12–20)	1 (0–1)	(0–4)	< 0.001
Function	36	61(59.75,62)	(55–67)	8 (6–10)	(5–12)	< 0.001
Stiffness	36	7 (7,8)	(6–8)	0 (0–1)	(0–2)	< 0.001
Min, Minimum; Max, Maximum						

Table 3
Univariate logistic regression for predictors of inpatient rehabilitation

	Variable	Odds Ratio (95% CI)	<i>P</i> value
Sex	Female	(Reference)	
	Male	1.6 (0.234–13.45)	<i>0.63</i>
Age		0.99 (0.8–1.12)	<i>0.9</i>
Previous Knee operation	No		
	Yes	2.33 (0.10–24.4)	<i>0.51</i>
Rheumatoid Arthritis	No		
	Yes	4.86 (0.6-100.96)	<i>0.178</i>
Total Knee Replacement	No		
	Yes	NA	<i>0.99</i>
Uncompartmentalized knee	No		
	Yes	NA	<i>0.995</i>
Duration of operation		0.914 (0.81–0.99)	<i>0.068</i>
Intraoperative blood loss		0.999 (0.991-1.00)	<i>0.93</i>
Diabetes mellitus	No		
	Yes	2.2 (0.098–23.5)	<i>0.52</i>
Hypertension	No		
	Yes	4.49 (0.48–37.16)	<i>0.15</i>
Hypothyroidism	No		
	Yes	7.5 (0.26–217.9)	<i>0.18</i>
CI, confidence interval			

Discussion

The heterogeneity of osteoarthritis arises from the many factors that can contribute to cartilage damage[23]. TKA is an efficient surgical intervention for improving mobility and function in elderly patients[24]. In this prospective study, we identified significant improvement in post-operative functional scores post-surgery in the predominantly elderly cohort of patients[25]. This suggest TKA to be a feasible option for restoring knee function even in elderly patients. This also requires good surgical practices from senior surgeons.

The finding was in agreement with the literature[26]. A poor pre-operative functional score was previously reported to predict a longer LOS, which could be due to the pre-operative need for walking aids that may extend hospitalization [27]. This study used a previously validated WOMAC score to assess the patients' actual functional mobility to provide a more accurate evaluation[26]. There are no previous studies based on regression models for analyzing short term functional outcome after TKA, especially in the elderly population. Subsequently, comparative analysis with previously reported studies is limited. Correlation between old age and a low pre-operative functional status has been reported to be predictive of inferior functional outcome after longer follow-up. The confounding effects of other factors, such as BMI, has not been conclusively reported. A previous study reported an inverse correlation between body weight and quality of life after > 5 years of follow-up[28, 29]. In comparison, other studies have reported BMI to be not associated with functional outcomes. We observed that patients with lower pre-surgical hemoglobin might require post-operative blood transfusion. This is in accordance with previous studies[30]. Older age might be a predictive factor for post-TKA complications such as increased risk of blood transfusion and infections[31]. No significant association between comorbidity and functional outcomes were reported from our analysis. Similarly, the presence of mental disorders also did not have any influence on functional outcomes.

This study had some inherent limitations due to its retrospective nature which might have led to unaccounted study bias. Factors like social status were not accounted for in this study which could also influence the LOS. However, the study patients were from a single specialist center which ruled out inter-surgeon skill difference and were provided with the same post-operative rehabilitation protocol.

Conclusions

In conclusion, our results suggest that if patients were properly selected for TKA, the functional outcomes could be improved and major surgery complications could be minimized.

Further, TKA could be a viable alternative even in the elderly population, provided the treating surgeons are experienced.

Abbreviations

ADL: Daily living activities

CCI: Charlson Comorbidity Index

OA: Osteoarthritis

PROM: Patient-reported outcome measure

QoL: Quality of life

TKA: Total Knee Arthroplasty

Declarations

Ethical Approval and consent to participate

The study was approved by the institutional ethical committee of the Hospital of Joint Logistic Support, Yunnan, China. (No. HJLS-2546) and has been performed in accordance with the ethical standards laid down according to the Declaration of Helsinki. The participants and/or attenders were orally explained as well as written informed consent was obtained from them prior to conducting the study.

Consent for publication

Not applicable

Availability of Data and Material

The datasets generated and/or analysed during the current study are not publicly available due to data confidentiality but are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests.

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Authors' contributions

NJ, XZ and YW conceptualized and designed the work. NJ, and YWu acquired and interpreted the data, performed statistical analysis and drafted the manuscript. XZ and YW critically revised the manuscript. YWu and YW provided technical and material support, and supervision. All authors read and approved the final manuscript.

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