

# Early Short-Term Rehabilitation Improves Patient Satisfaction For Total Knee Arthroplasty On Discharge: A Retrospective Observational Study

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## Research Article

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# Abstract

**Background:** Early initiated rehabilitation is generally thought to be conducive in achieving optimal results following total knee arthroplasty (TKA). However, the impact of early rehabilitation on patient satisfaction has not been elucidated. The purpose of this study was to investigate the effect of an early short-term rehabilitation by therapist on inpatient satisfaction and functional outcomes.

**Methods:** We retrospectively evaluated 2 cohorts of patients who had undergone TKAs between November 1, 2020, and August 31, 2021. Patients in therapist group received a therapist-led rehabilitation program, while patients in conventional group received a common rehabilitation program guided by surgeons. The programs were both started on postoperative day (POD) 1 and lasted for 3 days. Outcomes included patient satisfaction, Numeric Rating Scale (NRS) pain score, range of motion (ROM) on POD4 and functional outcomes at 3 and 6 weeks postoperative.

**Results:** A total of 113 patients (79% female) were included, with 59.2% were satisfied, and 40.8% dissatisfied. In the multivariable logistic regression analysis, therapist rehabilitation significantly improved the overall satisfaction (2.5; 95% CI, 1.1-5.7) and ROM (7.5°; 95% CI, 1.9-12.7) respectively, but reduced pain without a significance as well as the functional scores at 3 weeks after surgery. The multivariate adjusted smoothing spline plots between age and satisfaction percent showed therapist is more important for patients over 65 years.

**Conclusion:** Early short-term therapist rehabilitation enhanced patient satisfaction and ROM during the inpatient time, especially for patients more than 65 years.

## Background

Total knee arthroplasty (TKA) is a very successful procedure for the treatment of end-stage osteoarthritis of the knee joint, with an increasing frequency each year.[1], [2], [3] With the aging world and demand for life quality of old people, projections of future surgical volumes suggest further substantial increases.[4], [5], [6] Although TKA is effective at reducing pain and improving physical function for most patients, around 20% report dissatisfaction with the postoperative outcome [7], [8], [9].

Postoperative rehabilitation is generally thought to be conducive in achieving optimal results after knee arthroplasty, yet the content of rehabilitation varies worldwide [10]. Early inpatient rehabilitation following TKA has been shown to have benefits on reducing hospital length of stay [11] and pain [12], [13], as well as improving joint range of motion (ROM) [14], [15], [16]. Early short-term rehabilitation provided by therapist is conducted in recent years, which is now a routine procedure for fast-track rehabilitation after TKA at our institution. In clinical practice, we observed that short-term bedside rehabilitation increased patient satisfaction through physiotherapy and communication with patients. However, not all patients showed an improved satisfaction level, implying an individual variation to the program. Moreover, the therapist rehabilitation added an extra cost upon the surgery for patients. Hence, some people doubt

whether the rehabilitation limited in such a short inpatient period is sufficiently affectable on patient satisfaction and functional outcomes.

Patient satisfaction after TKA can be associated with patients' expectations [17], [18], pain relief, and functional improvement [19]. During the early postoperative period, patients' ROM, function, walking and balance are all limited and varied widely, or some cannot be quantified in the early time, which therefore are inappropriate for evaluating TKA outcomes *only* using these objective factors. What's more, even good objective parameters are not equal to subjective satisfaction of patient. Recent years, patient-reported outcome measures (PROMs), measuring pain, functioning, joint awareness or satisfaction after TKA from a patient's perspective, have significantly received more attention [20]. This patient-centric philosophy uses patient satisfaction as a metric of quality of patient care as opposed to the traditional, physical outcome measurements [21]. Therefore, we measured pain, ROM, patient satisfaction as the outcomes to evaluate the effects of early short-term rehabilitation after TKA.

To our best knowledge, there are few studies on the clinical effects of early inpatient rehabilitation for TKA simultaneously refer to subjective patient satisfaction and objective functional outcomes. The purpose of this study was to determine the effects of short-term postoperative physiotherapy provided by physical therapist on knee pain, ROM, and satisfaction among patients who were admitted to undergo TKA.

## Methods

### Participants

We retrospectively reviewed prospectively collected data of 137 consecutive patients who underwent primary TKA between November 1, 2020, and August 31, 2021 at Qilu Hospital of Shandong University, a single tertiary institution in China. As all data were from the records of routine medical procedures and no patient-identifiable data were used, the informed consent was waived and the study was exempted by our institutional review board. The majority of TKA surgeries were performed by the two senior authors. The surgeries were performed through a standard medial parapatellar approach with patellar eversion, followed by measured resection and gap-balancing techniques.

Inclusion criteria were: diagnosis of knee osteoarthritis for a unilateral TKA and over 50 years of age. Patients undergoing a revision, or surgery to address tumors were excluded. 113 patients were available for this study leaving the diagnosis of rheumatoid arthritis (n = 11), age less than 50 years (n = 1), previous history of ipsilateral knee surgery (n = 1), the postoperative hospital stay was less than 3 days (n = 3), refused to follow up (n = 2) and missing data (n = 6) (Fig. 1). The following preoperative information were collected: gender, age, height, weight, body mass index (BMI), education level, occupation.

### Treatment intervention

The control group, usual surgeon rehabilitation is comprised of a 5 min guidance on way to exercise and examination on the motion level of operated knee upon his daily ward rounds.

The intervention group, therapist rehabilitation program, in addition to usual surgeon rehabilitation, was in accordance with our institution's standardized integrated care pathway. For patients admitted to therapist group, physical therapists came to the bedsides and performed once-daily rehabilitation program for 30–40 min involving education on TKA rehabilitation literacy and physical therapy, including continues passive motion, manual therapy, neuromuscular electrical stimulation and communication (content refer to psychological comfort and expectation correction or adjustment but is not limited).

## Outcomes

Patients reported satisfaction for the overall procedures and rehabilitation was considered as the primary outcomes. Patients were asked to score their comprehensive subjective satisfaction level, which was related to the operation, postoperative rehabilitation, care after surgery, function, pain, cost, expectation or any factors about the hospitalization, on POD1 and POD4. The scores were recorded using a 10-level scales, with higher scores indicating better results. We further stratified the scores into satisfied/unsatisfied as the following level scale: dissatisfied (0 to 5), and satisfied (6 to 10). (Table 1).

Table 1  
Evaluation of patient satisfaction

Score	Patient satisfaction	Stratification
1, 2	Terrible	Dissatisfied
3	Poor	
4, 5	Fair	
6, 7	Good	Satisfied
8, 9	Very good	
10	Excellent	

Range of motion (ROM), Numeric Rating Scale (NRS) pain score and functional scores were used as secondary outcomes. ROM was calculated by subtracting extension angle from flexion angle. Active flexion and extension angles were measured to the nearest 0.5° using a goniometer while patient in supine position on POD1 and POD4. The intensity of pain experienced by the patient was evaluated using an 11-point NRS pain score, which ranged from 0 (no pain) to 10 (worst pain imaginable). Functional scores involving Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores, International Knee Documentation Committee (IDKC) scores and Lysholm knee score scale were measured at 3 and 6 weeks after surgery.

This study complied with the Helsinki Declaration and all experimental protocols were approved by Qilu Hospital of Shandong University.

# Statistical Analysis

We used the Chi-squared tests for categorical variables, one-way ANOVA for normally continuous variables, and the Kruskal-Wallis test for the skewed continuous variables. Regression coefficient and corresponding 95% confidence intervals (CI) were calculated using unadjusted and multivariate-adjusted logistic regression analyses to determine associations between therapist rehabilitation and inpatient satisfaction. We selected these confounders on the basis of their associations with the outcomes of interest or a change in effect estimate of more than 10%. The multivariate model was adjusted for gender, age, body mass index (BMI), education level, and occupation. To examine the nonlinear association between age and satisfaction proportion, we further applied a two-piecewise linear regression model using a smoothing function. The threshold level was determined using trial and error, including selection of turning points along a pre-defined interval and then choosing the turning point that gave the maximum model likelihood.

A propensity score (PS) applying the method of nearest neighbor matching without replacement was used to assess the effects of postoperative short-term rehabilitation, in order to minimize the potential confounding bias which could influence the results. Matching was performed with the use of a 1:1 matching protocol without replacement (greedy-matching algorithm), with a caliper width equal to 0.05 of the standard deviation of the logit of the propensity score. The therapist rehabilitation group was matched on gender, age, height, weight, body mass index (BMI), NRS, education level and occupation with surgeon rehabilitation group. Standardized differences were estimated for all the baseline covariates before and after matching to assess pre-match imbalance and post-match balance. Standardized differences of less than 10.0% for a given covariate indicate a relatively small imbalance [22]. In the matched cohort, paired comparisons were performed with the use of McNemar's test for binary variables and a paired Student's t-test or paired-sample test for continuous variables.

All statistical analyses were performed with R packages (<http://www.r-project.org>) and Empower (R) ([www.empowerstats.com](http://www.empowerstats.com), X&Y solutions Inc., Boston, MA. A *p* value of < .05 was taken to be significant.

## Results

In this retrospective cohort study, 137 patients operated for TKA after osteoarthritis from November 1, 2020 to August 31, 2021 were reviewed by the first author.

Upon comparing the surgeon guide rehabilitation group (n = 72, 85.4%) and therapist-led rehabilitation group (n = 41, 14.6%), there were no significant differences in baseline characteristics, including age (62.9 vs 64.4 years), BMI (28.0 vs 27.4 kg/m<sup>2</sup>), occupation, education level, NRS score (3.7 vs 4.1), extension, 14.8° vs 13.5°; flexion, 75.2° vs 79.0°), ROM (60.4° vs 65.5°) and satisfaction on POD1 (Table 2).

Table 2  
Baseline Characteristics and main measured outcomes before rehabilitation <sup>a</sup>.

Variables	Usual care (N = 41)	Therapist (N = 72)	P-value
Age (y)	62.9 ± 6.3	64.4 ± 5.7	0.195
Gender			0.273
Male	11 (26.83%)	13 (18.06%)	
Female	30 (73.17%)	59 (81.94%)	
Height (m)	1.60 ± 0.07	1.61 ± 0.06	0.803
Weight (kg)	72.0 ± 9.6	70.8 ± 9.7	0.508
BMI (kg/m <sup>2</sup> )	28.04 ± 3.45	27.40 ± 3.40	0.337
Occupation			0.660
Worker/Farmer	37 (90.24%)	63 (87.50%)	
Others	4 (9.76%)	9 (12.50%)	
Education level			0.104
Under high school	31 (75.61%)	63 (87.50%)	
Above high school	10 (24.39%)	9 (12.50%)	
Postoperative Day 1/Before short-term postoperative rehabilitation			
NRS	3.7 ± 2.1	4.1 ± 2.4	0.379
Extension (°)	14.8 ± 5.6	13.5 ± 6.8	0.319
Flexion (°)	75.2 ± 16.7	79.0 ± 17.4	0.254
ROM (°)	60.4 ± 17.6	65.5 ± 16.4	0.125
Satisfaction			0.799
Dissatisfied	36 (87.80%)	62 (86.11%)	
Satisfied	5 (12.20%)	10 (13.89%)	

<sup>a</sup> Values are presented as mean ± standard deviation (SD) for continuous variables, and as percentage for categorical variables. For baseline characteristics analysis, the statistical differences between short-term postoperative rehabilitation provided by therapist and surgeon groups were tested with t-test or one-way ANOVA for continuous variables and chi-square or fisher test for categorical variables.

Abbreviations: BMI, body mass index; NRS, visual analogue scale; ROM, range of motion; POD1, Postoperative Day 1

The distribution of outcomes on POD4 was showed in Table 3. Among the outcomes, extension angle, ROM, and satisfaction are significantly different between the two groups.

Table 3  
Distribution of outcomes on POD4

<b>Variables</b>	<b>Usual care (N = 41)</b>	<b>Therapist (N = 72)</b>	<b>P-value</b>
NRS	4.2 ± 1.9	4.0 ± 2.1	0.694
Extension (°)	12.8 ± 5.5	10.4 ± 5.0	<b>0.018</b>
Flexion (°)	88.4 ± 13.7	93.2 ± 14.6	0.090
ROM (°)	75.6 ± 14.7	82.8 ± 14.2	<b>0.012</b>
Satisfaction			<b>0.034</b>
Dissatisfied	22 (53.7%)	24 (33.3%)	
Satisfied	19 (46.3%)	48 (66.7%)	
POD4, Postoperative Day 4			

Univariate logistic regression analysis revealed that patient satisfaction was significantly associated with therapist rehabilitation with an OR of 2.32 (95% CI, 1.06–5.08; P = .036), compared with basic surgeon rehabilitation. Flexion degree is also an important factor to predict a higher satisfaction (OR, 1.06, 95% CI, 1.02–1.09; P = .0010). (Table 4).

Table 4  
Univariate Logistic Regression to Identify Factors Associated with Patients Satisfaction

	Statistics	Satisfaction OR (95%CI)	p-value
Rehabilitation			
Usual care	41 (36.3%)	1.0	
Therapist	72 (63.7%)	2.32 (1.06, 5.08)	<b>0.036</b>
Gender			
Male	24 (21.24%)	1.0	
Female	89 (78.76%)	0.67 (0.26, 1.73)	0.409
Age (y)	63.8 ± 6.0	0.99 (0.93, 1.06)	0.763
Height	1.61 ± 0.07	3.07 (0.01, 940.60)	0.701
Weight	71.2 ± 9.7	0.99 (0.96, 1.03)	0.746
BMI	27.63 ± 3.42	0.97 (0.87, 1.08)	0.550
Occupation			
Worker/Farmer	100 (88.50%)	1.0	
Other	13 (11.50%)	1.11 (0.34, 3.64)	0.861
Postoperative Day 4/After short-term postoperative rehabilitation			
NRS	4.1 ± 2.0	0.93 (0.77, 1.12)	0.463
Extension	11.3 ± 5.3	1.08 (1.00, 1.16)	0.061
Flexion	91.5 ± 14.4	1.06 (1.02, 1.09)	<b>0.001</b>
ROM	80.2 ± 14.8	1.04 (1.01, 1.07)	<b>0.008</b>

In the multivariable logistic regression analysis, after all confounding factors (including gender, age, BMI, NRS, education level, occupation) were taken into account, the therapist-led rehabilitation was significantly associated with an increase of the overall satisfaction (2.5; 95% CI, 1.1–5.7) and ROM (7.5°; 95% CI, 1.9–12.7). Compared with crude regression analyses, the associations did not change markedly after adjusting for gender, age, BMI (Adjust I), or confounders as Gender; Age; BMI; Occupation; NRS; ROM (Adjust II) in the multivariable regression analyses. The therapist rehabilitation did reduce the NRS, but without a significant p value and the small decrease doesn't have any clinical meaning (Table 5). Regarding the functional scores at 3 and 6 weeks after surgery, we found no meaningful differences. (Table S1)

Table 5

Multivariate Logistic Regression Analysis for outcomes of early therapist rehabilitation compared with usual surgeon rehabilitation

Outcomes	Non-adjusted		Adjust I		Adjust II	
	$\beta$ / OR (95% CI)	P value	$\beta$ / OR (95% CI)	P value	$\beta$ / OR (95% CI)	P value
Satisfaction	2.3 (1.1, 5.1)	0.036	2.5 (1.1, 5.7)	0.026	2.2 (0.9, 4.8)	0.092
ROM (°)	7.2 (1.7, 12.8)	0.012	7.6 (2.0, 13.2)	0.009	7.3 (1.9, 12.7)	0.009
NRS	-0.2 (-0.9, 0.6)	0.694	-0.2 (-1.0, 0.6)	0.695	-0.2 (-0.7, 1.0)	0.713
Non-adjusted model adjust for: None						
Adjust I model adjust for: Gender; Age; BMI						
Adjust II model adjust for: Gender; Age; BMI; Occupation; NRS; ROM						

We conducted a multivariate adjusted smoothing spline plots of age vs percent of satisfaction (Fig. 2). Patients who had underwent short-term postoperative rehabilitation provided by therapist showed a higher probability of satisfaction. For patients more than 65 years old, the short-term postoperative rehabilitation provided by therapist increase patient satisfaction significantly, whereas for patients under 65 years old, the short-term rehab may not do much on satisfaction improvement.

We also performed a propensity-score matching, 38 patients who accepted therapist rehabilitation program and 38 received basic surgeon rehabilitation had similar propensity scores and were included in the analyses. After matching, the standardized differences were less than 10.0% for all variables, indicating only small differences between the two groups (Supplementary Table S2-S4). In the matching population, the above results are consistent.

## Discussion

The present study demonstrated that the early short-term inpatient rehabilitation provided by therapist significantly improved patient satisfaction, and increased knee flexion ROM, compared with usual surgeon guided rehabilitation. What's more, the improvement of flexion ROM is an important factor associated with satisfaction. Consequently, we concluded that therapist led short-term postoperative rehabilitation may raise patient satisfaction though increasing the flexion ROM. In addition, we verified this conclusion by adjusting for baseline differences between the two groups with PSM scores.

Commonly, function and mobility are limited after TKA, burdening patients of worries about the future active daily life or return to sports. Therefore, a good outcome in the short period before discharge would relieve the anxiety, which is indeed important to the long-term effects of TKA. The core idea of enhanced recovery after surgery (ERAS) is to reduce surgical stress response, alleviate pain during perioperative period, reduce the incidence of complications, accelerate functional recovery, and improve patient

satisfaction. Early inpatient rehabilitation was conducted to improve pain, mobility and range of motion and facilitate ERAS.

Patient PROM satisfaction is an increasing focus to assess the outcomes of TKA. Regarding the satisfaction in the prior studies was either from the comparison between different physical therapy started timings [15] or from the assessment of treatment [23]. As we acknowledge that patient satisfaction may relate to many factors, which is possible to be far from the satisfaction evaluated from functional data by surgeons. That is why many surgeons confused by the dissatisfaction from a patient with a very good function recovery and pain relief. We used the patient subjective feeling for the overall inpatient treatment and his present situation to generate a satisfaction score, avoiding the misunderstanding gap. Therefore, focus on the patient subjective satisfaction may improve the medical care better.

Our study found that the satisfaction was obviously improved in patients received therapist led rehabilitation compared to the usual therapy led by surgeons. The short-term overall satisfaction was lower than previous reported results obtained by a long postoperative follow-up (69% vs 80%) [24]. This is most likely due to the limited function, muscle strength and flexibility of the knee in the short term, especially regarding the swelling and pain of the affected limb, which doesn't meet the patient's expectations at that time.

ROM is considered as a measure to determine the success of TKA surgery, as well as an indicator of postoperative physiotherapy. It was identified of an improved active knee ROM on discharge in the intervention group, which may reflect the increased level of postoperative mobilization and strengthening exercises these patients received [14]. Our results showed a nearly 8° increase in active ROM in the therapist rehabilitation group compare favorably with a prospective trial incorporating additional passive ROM exercises in addition to standard postoperative rehabilitation.

There are few reports on the relationship between ROM and satisfaction, and the relationship remains unclear. Ha et al first reported that patient satisfaction did not correlate with postoperative flexion but correlated with an improvement in the flexion angle [25]. Recently, Kubo et al showed a similar result, stating that the postoperative flexion angle had a significant effect on knee function and improvement in the flexion angle had a significant effect on patient satisfaction. [20] Consistently, the flexion degree improvement was favorable in terms of satisfaction in the multivariable analysis in this study.

Although several studies have suggested that early rehabilitation reduced opioid use during hospitalization [26], we didn't observe a difference of pain scores between the two groups. In addition, short-term postoperative inpatient rehabilitation didn't influence WOMAC scores, IDKC scores and Lysholm knee score scale at 3-week follow up. Our study only collected these data at three- and six-week follow up. No data were collected at hospital discharge because the recovery period was short during hospital stay leading to patient active daily life was influenced much.

The present study has several strengths in the context of the previous literature. First, we identified that the early therapist rehabilitation did enhance the patient satisfaction. Second, we found a subgroup of patients, aged over 65 years, may benefit more from an early therapist rehabilitation program. Considering this finding, we recommend surgeons should try their bests to arrange the therapist rehabilitation for patients aged over 65.

A primary limitation of this study is that it was conducted at a single site. We will include more cases in the future study. Secondly, although there are many studies confirmed the relationship between met satisfaction and patient satisfaction [17], [18], expectation scores were not prospectively collected in the retrospective study. Nevertheless, knee joint swelling, pain, limited mobility and other complications were informed by the surgeons during the preoperative education, when patient knew that there was no way to achieve the expectation in the short hospitalization, indicating the expectation was not a determinant of short-term satisfaction. Thirdly, the enhanced communication between doctors and patients may improve the patient subjective satisfaction. In this case, the therapists' accompany and interaction with the patient during the bedside rehabilitation would increase the communication. But in this retrospective study, the communication was not collected in advance. Finally, it is important to acknowledge that statistical significance on a patient reported outcome measure does not always imply clinical significance [27], [28]. The mid- and long-term effects need further research in larger patient cohorts with a longer follow-up.

## Conclusions

Our study identifies that early short-term inpatient rehabilitation provided by therapist enhanced the patient reported satisfaction probably through improving the ROM on discharge. We also found the therapist rehabilitation may influence the satisfaction much more in patients aged over 65 years. Although it hasn't influenced the long-term functional outcomes, the early rehabilitation has improved short term patient outcomes as a routine procedure for fast-track rehabilitation, which may support early rehabilitation and physiotherapy protocols.

## List Of Abbreviations

BMI, body mass index; CI, confidence interval; NRS, Numeric Rating Scale; POD, Postoperative day; PROMs, patient-reported outcome measures; ROM, range of motion; TKA, total knee arthroplasty; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; IKDC, International Knee Documentation Committee

## Declarations

### Ethical approval and consent to participate

As all data were from the records of routine medical procedures and no patient-identifiable data were used, the informed consent was waived and the study was exempted by the institutional review board at

Qilu Hospital of Shandong University.

### **Consent for publication**

Not applicable.

### **Availability of data and materials**

The datasets during and/or analyzed during the current study available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interests.

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### **Author Contributions**

X.Y.M. and G.F.D. were primarily responsible for study design. Z.G., L.T.L. and J.W. conducted recruitment and data collection, with input from all other authors. X.Y.M. conducted data analysis and wrote this manuscript, with the greatest assistance from C.W, and all authors provided approval to the final manuscript.

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## Figures

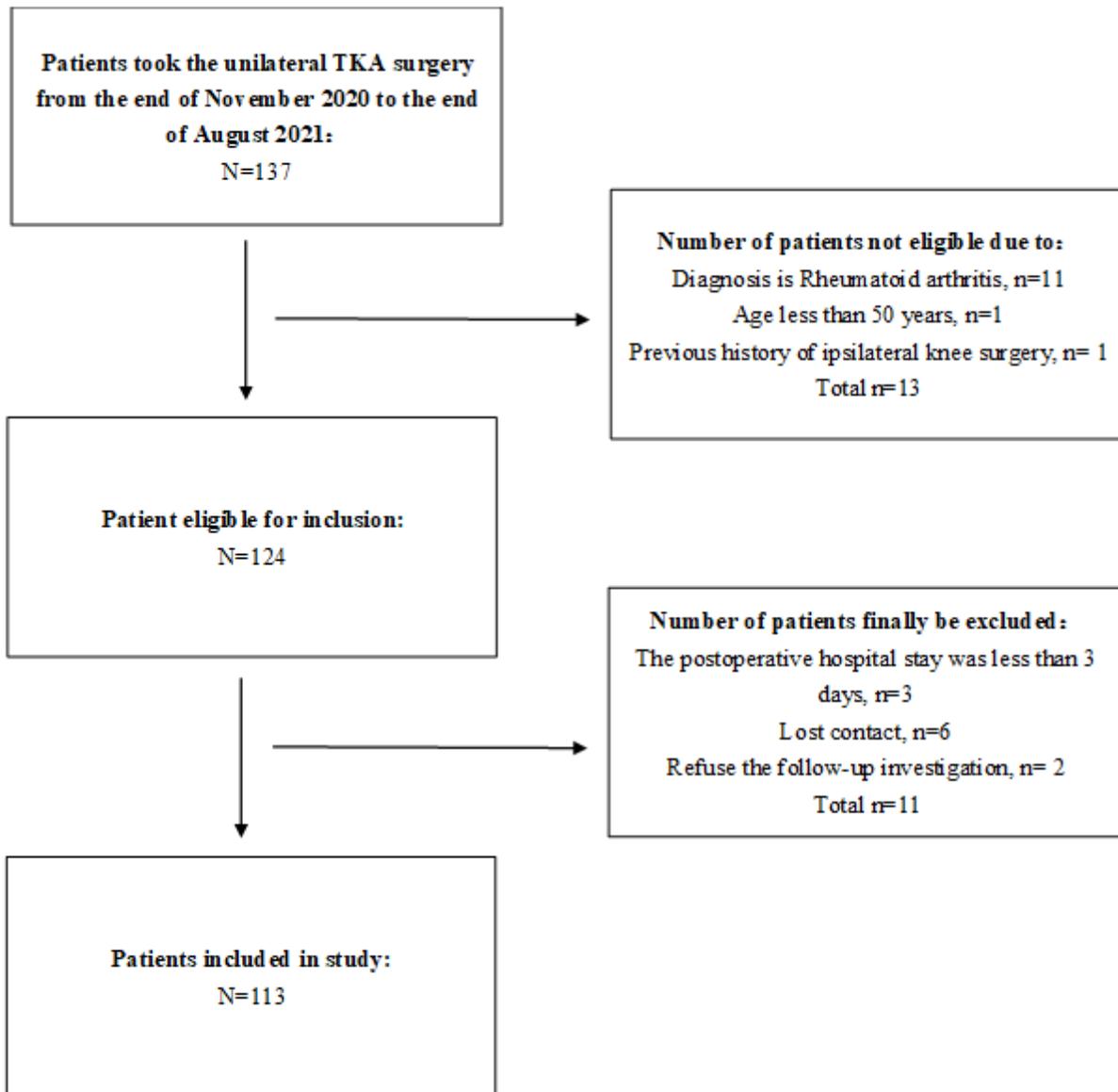


Figure 1

Flow chart. Patients included and excluded.

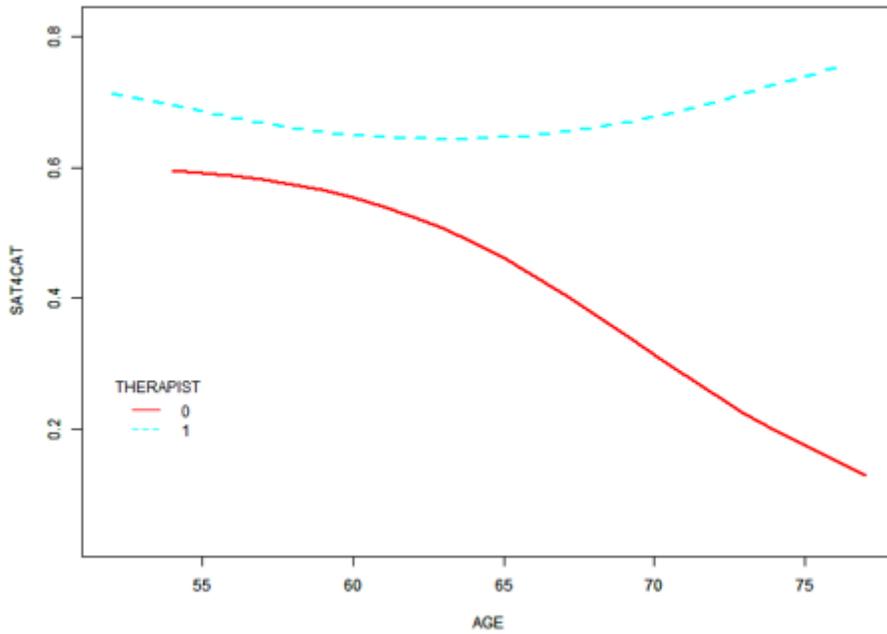


Figure 2

**Multivariate adjusted smoothing spline plots of age vs percent of satisfaction.** The red line indicates formal surgeon group and blue indicates therapist rehabilitation group. SATCAT, percent of satisfaction

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [SupplementaryTables.docx](#)