

Reasons and Factors Behind Post-Total Knee Arthroplasty Dissatisfaction in an Asian Population

Yilun Huang,¹ MBBS, MRCS, Merrill Lee,¹ MBBS, Hwei Chi Chong,¹ BAppSc (Physio), Yilin Ning,² BS, Ngai Nung Lo,¹ MBBS, FRCS (Edin), FAMS, Seng Jin Yeo,¹ MBBS, FRCS (Edin), FAMS

Abstract

Introduction: Up to 20% of patients who underwent total knee arthroplasty (TKA) reported dissatisfaction with surgical outcome. Despite the multiple studies looking into the factors contributing to patients' dissatisfaction, little research has been done to examine the subjective reasons and complaints patients have post-arthroplasty. This study aimed to look at an Asian patient population which underwent TKA and examine the factors contributing to patient dissatisfaction and the reasons they were dissatisfied with their surgery. **Materials and Methods:** A total of 3069 TKAs were performed between January 2011 to April 2013 in a single institution. Preoperative and postoperative variables were prospectively captured, such as standardised knee scores, knee range of motion and patient satisfaction scores. These variables were then analysed with a multiple logistic regression model to determine the statistically significant factors that contribute to patients' satisfaction. Dissatisfied patients were individually interviewed to find the reasons for their unhappiness. Preoperative variables were then analysed to identify the statistically significant factors associated with these subjective complaints. **Results:** Minimum duration of follow-up was 2 years, with an overall patient satisfaction rate of 91.3%. Preoperative variables contributing to patient dissatisfaction included female gender and better knee flexion. Postoperative variables included lesser improvement in knee flexion at 6 months postoperatively, as well as poorer scores in various validated knee scores at both 6 months and 2 years postoperatively. The top reason for dissatisfaction was pain. Weakness, another reason for patient dissatisfaction, had statistically significant preoperative predictors of increased age and poorer Short-Form 36 Physical Component Score. **Conclusion:** Although TKA has an impressive patient satisfaction rate in this Asian population, factors contributing to postoperative dissatisfaction suggest a targeted group of patients would benefit from preoperative counselling. The top reason for postoperative dissatisfaction in the study was pain.

Ann Acad Med Singapore 2017;46:303-9

Key words: Outcomes, Quality of life, Satisfaction

Introduction

Up to 20% of patients who underwent total knee arthroplasty (TKA) were reported to be dissatisfied with the surgical outcome.¹⁻³ There is, however, less information available on the reasons behind these patients' unhappiness. Such information would be helpful as satisfaction post-arthroplasty is fast becoming an important outcome measure post-surgery.^{4,5}

Previously, orthopaedic surgeons have used the need for revision surgery as an indicator of arthroplasty failure,

neglecting the more subjective component of patient satisfaction.^{6,7} Unfortunately, satisfaction is multifactorial and the literature has demonstrated a discrepancy between clinician and patient ratings of quality of life.^{8,9} Patient satisfaction is dependent on both the mental and physical health of the patient, and is influenced by the fulfilment of patients' expectations aside from absolute function.^{10,11}

So far, the literature has no consensus regarding specific factors predictive of patient satisfaction. Evidence is even less established in Asian populations, where although

¹Department of Orthopaedic Surgery, Singapore General Hospital, Singapore

²Yong Loo Lin School of Medicine, National University of Singapore, Singapore

Address for Correspondence: Dr Merrill Lee, Department of Orthopaedic Surgery, Singapore General Hospital, 20 College Road, Academia, Level 4, Singapore 169865.

Email: merrilllee91@gmail.com

patients have been expected to demand higher knee flexion post-TKA as compared to the Western population, a recent study has shown that a lack of postoperative range of motion (ROM) does not translate into poorer outcome scores and dissatisfaction in an Asian population.¹²

In this study, we hypothesised that there are preoperative and postoperative variables associated with patient dissatisfaction post-TKA. Discovery of the reasons behind patient dissatisfaction as well as possible contributory factors may allow surgeons to achieve better subjective outcomes.

Materials and Methods

Participants

A total of 3069 TKAs performed from January 2011 to April 2013 were prospectively enrolled in this study with a minimum follow-up period of 2 years. Local institutional review board (IRB) waiver was granted as no patient identifiable data was used in this study.

Indications

All TKAs were performed for primary osteoarthritis of the knee which clinically indicated the patient for a routine TKA. Patients who underwent bilateral TKA performed in the same setting were included in the study population as well. Exclusion criteria included patients with inflammatory arthritis, post-traumatic arthritis or a history of septic arthritis. Patients with a history of prior contralateral TKA, as well as any other concomitant procedure, including removal of hardware, were also excluded.

Components and Technique

All the operations were performed by 5 qualified surgeons from the institution's orthopaedic surgery department. All procedures were performed through a midline incision with a medial parapatellar arthrotomy. All implants were fixed bearing, with either posterior stabilised (PS) or cruciate retaining (CR) designs.

Postoperative Treatment

Postoperative physiotherapy comprised 4 phases across the duration of approximately 12 weeks. This was a generalised protocol which physiotherapists modified accordingly for individual patients based on their improvement and progress. The patients were brought through the following phases.

Phase 1

The confidence and mobility phase had the following aims: 1) to decrease pain and oedema; 2) to progress knee flexion to at least 90°; 3) to do a straight leg raise without

lag; and 4) to be independent with bed mobility and transfers. This typically occurred over the first week when the patient was an inpatient.

Phase 2

The initial outpatient phase had the following goals: 1) to decrease pain and oedema; 2) to progress knee flexion to 110°; 3) to increase/maintain lower limb strength; 4) the normalisation of gait pattern; and 5) for independent ambulation in the community. This occurred over weeks 2 to 5 (the initial outpatient period).

Phase 3

The semi-independent phase had the following aims: 1) to further increase knee flexion, if possible; 2) to increase cardiovascular endurance; and 3) to maximise balance, proprioception, strength and endurance of the lower extremity. This occurred over weeks 6 to 8.

Phase 4

Phase 4 was the independent phase. The aims were to: 1) improve strength; 2) improve movement strategies and movement efficiency of activities; and 3) modify activities, if necessary (e.g. no high impact sports/activities). This occurred over weeks 9 to 12, and can be extended as long as necessary.

Data Collection

Key preoperative and postoperative variables were collected, along with patient satisfaction postoperatively. Data was captured by trained personnel during each patient's follow-up in the Orthopaedic Surgery Clinic at 6 months as well as 2 years postoperatively; drop-out rate was captured to assess for non-responder bias. Two-time points were used to measure changes and improvements in surgical outcome.

Preoperative variables captured included the patient's age, gender and body mass index (BMI). ROM of the knee, as well as validated knee scores such as the Oxford Knee Score (OKS), function score and knee score from the Knee Society Clinical Rating System were also collected.

The OKS is a 12-item questionnaire specifically designed and developed to assess function and pain after knee arthroplasty.¹³ The Knee Society Clinical Rating Score is a different knee rating system subdivided into a knee score that rates only the knee joint itself and a function score that rates the patient's ability to walk and climb stairs; the dual-rating system was developed to eliminate the problem of declining knee scores associated with patient infirmity.¹⁴

Both preoperative and postoperative ROM of the knee

was captured via goniometry. Both flexion and extension of the knee was recorded – a flexion value of 90 would mean that the patient was capable of flexion of the knee to 90 degrees, an extension value of 0 would refer to the patient being able to extend the knee fully, and an extension value of 10 would imply a fixed flexion deformity of 10 degrees.

To assess the impact of the procedure on each patient's quality of life, individual components of the Short-Form 36 (SF-36) health survey were captured, and the composite Physical Component Summary (PCS) and Mental Component Summary (MCS) were calculated. The SF-36 is a multipurpose short-form health survey which yields physical and mental health summary measures. The PCS of the SF-36 correlates well with physical functioning and pain while the MCS of the SF-36 correlates well with mental health and social functioning.

Postoperative variables captured included the OKS, ROM, knee and function score as well as the PCS and MCS calculated from SF-36 scores.

Patient satisfaction scores were recorded on a Likert scale of 1 to 6, with 1 representing excellent satisfaction and 6 representing extreme dissatisfaction. This was adapted from Question 53 of the North American Spine Society Questionnaire. In order to capture a binary score, the overall satisfaction grade was categorised into 2 groups – patients who answered 1, 2, and 3 were assigned to the satisfied group while those who answered 4, 5, and 6 were assigned to the dissatisfied group.

In order to capture qualitative insight into the reasons for patients' dissatisfaction, all patients who had indicated dissatisfaction during their assessments were invited to elaborate on the reasons for their dissatisfaction. The reasons each patient provided were subjective; no formal questionnaire was used during this process. These reasons were categorised into 4 main headings: pain, stiffness, weakness, and others. These categories were based on clinical experience from previous patients' responses during follow-up sessions, as well as predominance of pain, stiffness and weakness as keywords within patient's complaints. These complaints were allowed to be assigned to more than 1 category.

All data, including preoperative and postoperative variables as well as reasons for dissatisfaction, were prospectively collected by hospital staff from the Orthopaedic Diagnostic Centre.

Statistics

The demographic and clinical profiles of participants were summarised by using the mean and standard deviation. A two-sample t-test was used to assess whether demographic and clinical characteristics were associated with non-

respondent status.

Simple logistic regression was performed on both preoperative and postoperative variables with patient dissatisfaction as the dependent variable. Multiple logistic regression model was obtained through a model-building process where the stepwise algorithm with Akaike information criterion (AIC) begins with a null model (i.e. a model with no predictors). The AIC was used to select the multiple logistic regression model because it favoured models with better fit and penalised overfitting.

In each step of the model-building process, predictors were added and removed from the model based on the AIC. The model-building process stopped when the removal or insertion of any variable did not result in an improvement in fit. The same steps were taken to identify the factors for dissatisfaction where the predictors considered were preoperative.

The odds ratios and the 95% confidence intervals were reported. A *P* value less than 0.05 was considered significant. The statistical analyses were performed with R.¹⁵

Results

A total of 2643 (out of 3069) were available for analysis with complete follow-up for 2 years (i.e. lost to follow-up rate of 13.8%). These 2643 TKAs were performed on 2483 patients with 160 of them having bilateral TKAs performed in the same setting. We will refer to this group of patients followed up for the complete 2-year period as the responder group while the group of patients we failed to follow-up on will be the non-responder group.

Data on Patients

The mean preoperative age, BMI, knee ROM and knee score values are reported for the responder and non-responder groups in Table 1. These variables were then compared using a two-sample t-test to see whether there was any significant difference between patients in these 2 groups.

Although there were statistically significant differences in preoperative BMI, OKS and functional score between the responder and non-responder groups, the absolute difference between the means were small, suggesting that the differences were unlikely to be of clinical significance. For example, the difference in mean OKS between the responders versus the non-responders is 1, which is less than the minimum clinically important difference in OKS after TKA, which is reported to be 5.0.¹⁶

There was no significant difference (*P* >0.05) in satisfaction between patients who had PS implants versus those with CR implants.

Table 1. Patient Demographics and Clinical Parameters at Baseline

Demographics	Responders (n = 2483)		Non-Responders (n = 426)		Comparison
	Mean	SD	Mean	SD	P for Two-Sample t-Test
Age (years)	67	8	67	9	0.715
BMI	27.8	4.7	28.7	5.5	0.002
Preoperative extension of knee (degrees)	7.1	7.3	7.8	8.3	0.114
Preoperative flexion of knee (degrees)	117.5	18.2	117.9	18.1	0.695
Preoperative OKS (points)	35	8	36	8	0.011
Preoperative knee score of the Knee Society Clinical Rating Score (points)	38	18	37	18	0.058
Preoperative functional score of the Knee Society Clinical Rating Score (points)	53	17	50	19	0.002
Preoperative PCS (points)	32	10	31	10	0.094
Preoperative MCS (points)	53	10	53	10	0.986

BMI: Body mass index; MCS: Mental Component Summary of Short Form-36 Health Survey Score; OKS: Oxford Knee Score; PCS: Physical Component Summary of Short Form-36 Health Survey Score; SD: Standard deviation

Clinical Results

The overall patient satisfaction rate at 2 years postoperatively was 91.3%. The breakdown of the respondents' satisfaction scores can be seen in Table 2. As mentioned above, patients with scores 1 to 3 were categorised as satisfied while those with scores 4 to 6 were categorised as dissatisfied postoperatively.

The preoperative variables significantly associated with patient dissatisfaction at 2 years were female gender, undergoing unilateral (instead of bilateral) TKA, having a poorer preoperative MCS, and most notably, having better preoperative flexion of the knee (Table 3). Age and BMI were not shown to be associated with patient dissatisfaction at both 6 months and 2 years.

The postoperative variables that were significantly associated with patient dissatisfaction at 2 years included poor OKS at both 6-month as well as 2-year intervals, poor flexion of knee at 6 months, and poorer knee score, MCS and PCS at 2 years.

Among the 229 patients who were dissatisfied, 157 (68.6%) provided comments regarding their dissatisfaction and these comments were categorised into 4 broad categories: pain, stiffness, weakness and others. Comments

from a single patient could fall into more than 1 category.

Among these 157 dissatisfied patients who provided comments, 85 patients had indicated pain (54.1%), 27 indicated stiffness (17.2%), 16 indicated weakness (10.2%) and 45 indicated others (28.7%). Examples of complaints falling under the “others” category included non-specific numbness over the operated knee, the feeling of a non-native knee, occasional clicking sounds arising from the operated knee, as well as subjective instability of the operated knee resulting in limitation of daily activities. These percentages do not total up to 100% as some of the patients' complaints fell into more than 1 category.

No significant preoperative factors were found to be associated with pain or stiffness as an attributor to dissatisfaction at 2 years postoperatively. Increased age and a poorer preoperative PCS were significantly associated with weakness as an attributor to dissatisfaction at 2 years postoperatively (Table 4).

Discussion

In our study, we have demonstrated changes in objective and subjective clinical outcomes for patients who underwent primary TKA. Consistent with other studies, our centre

Table 2. Breakdown of Satisfaction Scores

Likert Scale	1	2	3	4	5	6
Number of responders	637	916	703	166	37	24
Categorisation	Satisfied			Dissatisfied		
Number of responders	2256			227		

Table 3. Factors Associated with Patient Dissatisfaction at 2 Years

Variables	OR	95% CI	P Value
Preoperative Variables			
Female gender	1.621	(1.095, 2.398)	0.015
Unilateral TKA	1.767	(1.057, 2.950)	0.030
Poorer MCS	1.038	(1.026, 1.052)	<0.001
Better preoperative flexion of knee	1.008	(1.001, 1.016)	0.043
Postoperative Variables			
Poorer flexion of knee at 6 months	1.013	(1.025, 1.003)	0.01
Poorer OKS at 6 months	1.042	(1.007, 1.079)	0.02
Poorer OKS at 2 years	1.123	(1.078, 1.170)	<0.01
Poorer preoperative knee score of the Knee Society Clinical Rating Score at 2 years	1.022	(1.010, 1.035)	<0.01
Poorer MCS at 2 years	1.025	(1.040, 1.010)	<0.01
Poorer PCS at 2 years	1.030	(1.010, 1.050)	<0.01

CI: Confidence interval; MCS: Mental Component Summary of the Short Form-36 Health Survey Score; OKS: Oxford Knee Score; OR: Odds ratio; PCS: Physical Component Summary of Short Form-36 Health Survey Score; TKA: Total knee arthroplasty

Table 4. Factors Associated with Patient Complaint of Weakness at 2 Years

Variable	P Value	OR	CI
Increased Age	0.028	1.090	(1.009, 1.178)
Poorer PCS	0.048	1.059	(1.001, 1.122)

CI: Confidence interval; OR: Odds ratio; PCS: Physical Component Summary of Short Form-36 Health Survey Score

had a low percentage of dissatisfaction with TKA. The top 3 reasons stated by our Asian patient cohort were pain, stiffness and weakness. Other less common reasons stated by patients included, for example, non-specific numbness and the feeling of a non-native knee.

Our data demonstrated that undergoing bilateral (as opposed to a unilateral) TKA appeared to be associated with improved patient satisfaction at 2 years postoperatively. However, the outcomes of bilateral TKA appear to be mixed within the current literature. Bagsby et al found significantly higher postoperative functional outcomes including total ROM, knee flexion and function score in patients who underwent bilateral TKA as opposed to unilateral TKA.¹⁷ The authors hypothesised that this was related to the absence of contralateral arthritis that produce painful and restricted rehabilitation. March et al found that patients who underwent bilateral TKA reported significantly better physical and social functions, reduced pain, and better general and mental health than those undergoing unilateral TKA.¹⁸ On the other hand, Zeni JA Jr et al performed a matched pair analysis between simultaneous bilateral TKA and unilateral unicompartmental knee arthroplasty and found comparable postoperative functional scores between the 2 groups.¹⁹ Multiple studies have also reported increased

perioperative complications associated with bilateral TKAs including deep venous thrombosis, fat emboli and increased blood transfusion requirements.^{20,21} Therefore we would recommend patients to be adequately counselled regarding the operative risks, and undergo appropriate patient selection prior to undergoing simultaneous bilateral TKA.²²

Interestingly, patients with better flexion of the knee preoperatively were more likely to be dissatisfied postoperatively. There are studies that had debated the importance of poor postoperative flexion as a predictor for patient dissatisfaction, whereas there is considerably less literature on preoperative range of motion.^{23,24} Fortin et al found that patients with lower preoperative physical function were not improved postoperatively to the level achieved by those with higher preoperative function.²⁵ Lingard et al demonstrated the strong influence of preoperative Western Ontario and McMaster Universities Arthritis Index (WOMAC) function score on postoperative outcomes at 1 and 2 years, stating that patients with a preoperative WOMAC function score in the lowest quartile were over 4 times more likely to have a score of ≤ 60 at 2 years following surgery than were patients in the other groups, indicating moderate functional limitation.²⁶ These 2 studies suggest that poor preoperative function would be linked to poor postoperative outcomes. On the other hand, the Swedish Joint Registry Study found that there was a proportional distribution of satisfaction related to the chronicity of disease state prior to arthroplasty.² Those with long-standing disease were more often satisfied; Dunbar et al¹ commented that patients compare their postsurgery state with their concept of a pre-diseased knee state of health. Hence, fully healthy people may be dissatisfied with a well functioning TKA,

whereas a patient with chronic disease would likely compare the result of surgery with their preoperative diseased state, resulting in a greater perception of satisfaction. We feel that patients with higher preoperative knee flexion are likely to be more active and with higher expectations of surgery, which may contribute to dissatisfaction even from a well functioning TKA. Despite the low odds ratio, it could be an important preoperative phenomenon to be considered by the orthopaedic surgeon during planning of surgery.

Poorer validated knee scores such as the OKS correlated with postoperative dissatisfaction at both 6 months and 2 years. We also considered changes in these scores between 6 months and 2 years, but they were not found to be significantly associated with postoperative dissatisfaction (results not shown). This finding was in line with a recent study performed on Korean subjects which showed that absolute postoperative scores were better correlated with patient satisfaction than preoperative to postoperative changes for all scales.²⁷ The authors have suggested that this may be attributed to patients revising their goals and expectations postoperatively.

Poor postoperative knee flexion at 6 months was also a predictor of patient dissatisfaction at 2 years postoperatively. This was also similar to another Asian study by Matsuda et al, which concluded that although patient satisfaction was difficult to measure, achieving better ROM appeared to be important for increasing patient satisfaction and meeting patient expectations.²⁸ The importance of early postoperative knee flexion has previously been demonstrated in a Western population by Williams et al, who described knee flexion at 3 months to be a significant predictor of subsequent 12-month satisfaction.²⁴

After eliciting the reasons for dissatisfaction from interviewing dissatisfied patients, we found that poorer preoperative PCS and older age are significant factors associated with subjective postoperative weakness; however, statistical analysis did not reveal any preoperative variables associated with post-TKA pain and stiffness. Exploration into this area would be a major contribution to patient outcomes, as a painful TKA is known to be a major predictor of patient dissatisfaction, yet its aetiology remains elusive.^{3,29}

With the above knowledge, orthopaedic surgeons can aim to optimise patient outcomes by firstly, considering bilateral TKA as a viable option in appropriately selected patients. Secondly, achieving improved knee flexion early on in the patient's recovery, such as by the 6-month mark, may result in improved patient satisfaction even after 2 years. Finally, a thorough preoperative assessment of patients can be performed, allowing surgeons to pick up factors such as good preoperative knee flexion, poorer preoperative PCS and older age. This would allow the surgeons to counsel

the patients accordingly with regards to their expectations of surgery as well as possible postoperative complaints such as weakness.

The strength of our study lies in the comprehensive collection of preoperative, intraoperative and postoperative variables from the patient population with a low drop-out rate; this allowed for robust multivariate analyses to estimate the impact of these variables on measured outcomes. Furthermore, our study was conducted in a single institution, with similar rehabilitation regimes arranged for all patients postoperatively.

One weakness of this study is the limited sample size, which may explain the lack of factors significantly associated with subjective postoperative pain and stiffness. With a bigger sample size, results may be more comprehensive. An improvement to the study could also be made by capturing the incidence of pain, weakness and stiffness in patients satisfied with their surgery; this would allow surgeons to understand if these adverse symptoms are uniquely associated with dissatisfaction or common to both patient groups.

Although this study is conducted in a single tertiary centre, varying surgical techniques employed by different surgeons as well as varying choice of implant may introduce heterogeneity in the observed outcomes. Future studies would be necessary to address these limitations, with recommendations such as using standardised implants and incorporating preoperative and postoperative radiological assessments.

Conclusion

Overall, we report high patient satisfaction of 91.3% for TKA in an Asian multiracial population. The top reason for postoperative dissatisfaction appears to be residual pain; further research into this area may eventually reveal predictors of subjective complaints, thus allowing orthopaedic surgeons to the target problem areas and maximise patient satisfaction.

REFERENCES

1. Dunbar MJ, Richardson G, Robertsson O. I can't get no satisfaction after my total knee replacement: rhymes and reasons. *Bone Joint J* 2013;95-B:148-52.
2. Robertsson O, Dunbar M, Pehrsson T, Knutson K, Lidgren L. Patient satisfaction after knee arthroplasty: a report on 27,372 knees operated on between 1981 and 1995 in Sweden. *Acta Orthop Scand* 2000;71:262-7.

3. Baker PN, van der Meulen JH, Lewsey J, Gregg PJ; National Joint Registry for England and Wales. The role of pain and function in determining patient satisfaction after total knee replacement: Data From The National Joint Registry For England And Wales. *J Bone Joint Surg Br* 2007;89:893-900.
4. Von Keudell A, Sodha S, Collins J, Minas T, Fitz W, Gomoll AH. Patient satisfaction after primary total and unicompartmental knee arthroplasty: an age-dependent analysis. *Knee* 2014;21:180-4.
5. Press I, Fullam F. Patient satisfaction in pay for performance programs. *Qual Manag Health Care* 2011;20:110-5.
6. Chou DT, Swamy GN, Lewis JR, Badhe NP. Revision of failed unicompartmental knee replacement to total knee replacement. *Knee* 2012;19:356-9.
7. Emerson RH Jr, Higgins LL. Unicompartmental knee arthroplasty with the Oxford prosthesis in patients with medial compartment arthritis. *J Bone Joint Surg Am* 2008;90:118-22.
8. Janse AJ, Gemke RJ, Uiterwaal CS, van der Tweel I, Kimpen JL, Sinnema G. Quality of life: patients and doctors don't always agree: a meta-analysis. *J Clin Epidemiol* 2004;57:653-61.
9. Lee M, Huang Y, Chong HC, Ning Y, Lo NN, Yeo SJ. Predicting satisfaction for unicompartmental knee arthroplasty patients in an Asian population. *J Arthroplasty* 2016;31:1706-10.
10. Scott CE, Bugler KE, Clement ND, MacDonald D, Howie CR, Biant LC. Patient expectations of arthroplasty of the hip and knee. *J Bone Joint Surg Br* 2012;94:974-81.
11. Scott CE, Howie CR, MacDonald D, Biant LC. Predicting dissatisfaction following total knee replacement: a prospective study of 1217 patients. *J Bone Joint Surg Br* 2010;92:1253-8.
12. Soon EL, Bin Abd Razak HR, Tan CS, Tan HC. Postoperative range of motion does not correlate with patient reported outcome scores in Asians after total knee arthroplasty. *J Arthroplasty* 2014;29:2285-8.
13. Dawson J, Fitzpatrick R, Murray D, Carr A. Questionnaire on the perceptions of patients about total knee replacement. *J Bone Joint Surg Br* 1998;80:63-9.
14. Insall JN, Dorr LD, Scott RD, Scott WN. Rationale of the Knee Society clinical rating system. *Clin Orthop Relat Res* 1989;248:13-4.
15. R Development Core Team. R: A language and environment for statistical computing. Available at: <http://www.R-project.org/>. Accessed on 30/07/15.
16. Clement ND, MacDonald D, Simpson AH. The minimal clinically important difference in the Oxford knee score and Short Form 12 score after total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc* 2014;22:1933-9.
17. Bagsby D, Pierson JL. Functional outcomes of simultaneous bilateral versus unilateral total knee arthroplasty. *Orthopedics* 2015;38:e43-7.
18. March LM, Cross M, Tribe KL, Lapsley HM, Courtenay BG, Cross MJ, et al. Two knees or not two knees? Patient costs and outcomes following bilateral and unilateral total knee joint replacement surgery for OA. *Osteoarthritis Cartilage* 2004;12:400-8.
19. Zeni JA, Snyder-Mackler L. Clinical outcomes after simultaneous bilateral total knee arthroplasty: comparison to unilateral total knee arthroplasty and healthy controls. *J Arthroplasty* 2010;25:541-6.
20. Lombardi AV, Mallory TH, Fada RA, Hartman JF, Capps SG, Kefauver CA, et al. Simultaneous bilateral total knee arthroplasties: who decides? *Clin Orthop Relat Res* 2001;392:319-29.
21. Pavone V, Johnson T, Saulog PS, Sculco TP, Bottner F. Perioperative morbidity in bilateral one-stage total knee replacements. *Clin Orthop Relat Res* 2004;421:155-61.
22. Memtsoudis SG, Hargett M, Russell LA, Parvizi J, Cats-Baril WL, Stundner O, et al. Consensus statement from the consensus conference on bilateral total knee arthroplasty group. *Clin Orthop Relat Res* 2013;471:2649-57.
23. Jacobs CA, Christensen CP. Factors influencing patient satisfaction two to five years after primary total knee arthroplasty. *J Arthroplasty* 2014;29:1189-91.
24. Williams DP, O'Brien S, Doran E, Price AJ, Beard DJ, Murray DW, et al. Early postoperative predictors of satisfaction following total knee arthroplasty. *Knee* 2013;20:442-6.
25. Fortin PR, Penrod JR, Clarke AE, St-Pierre Y, Joseph L, Belisle P, et al. Timing of total joint replacement affects clinical outcomes among patients with osteoarthritis of the hip or knee. *Arthritis Rheum* 2002;46:3327-30.
26. Lingard EA, Katz JN, Wright EA, Sledge CB; Kinemax Outcomes Group. Predicting the outcome of total knee arthroplasty. *J Bone Joint Surg Am* 2004;86-A:2179-86.
27. Kwon SK, Kang YG, Kim SJ, Chang CB, Seong SC, Kim TK. Correlations between commonly used clinical outcome scales and patient satisfaction after total knee arthroplasty. *J Arthroplasty* 2010;25:1125-30.
28. Matsuda S, Kawahara S, Okazaki K, Tashiro Y, Iwamoto Y. Postoperative alignment and ROM affect patient satisfaction after TKA. *Clin Orthop Relat Res* 2013;471:127-33.
29. Noble PC, Conditt MA, Cook KF, Mathis KB. The John Insall Award: patient expectations affect satisfaction with total knee arthroplasty. *Clin Orthop Relat Res* 2006;452:35-43.