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Objectives

To compare patient-reported outcomes (PROs) after Total knee arthroplasty (TKA) across TKA procedures and PRO-domains.

Methods

We analysed a TKA registry from a Singapore tertiary hospital, including 20 PRO items (12 from Oxford Knee Score, five from EQ-5D-3L, and three from Knee Society Score) collected preoperatively and 6-month, 1-, 2-, and 5-year postoperatively. Postoperative improvement was assessed using proportion improved and Cliff's δ (averaged across items), to compare across TKA procedures: unilateral, simultaneous bilateral (SimBTKA), and staged bilateral (StaBTKA) where the first (initial TKA on one knee, StaBTKA₁) and second (subsequent TKA on the contralateral knee, StaBTKA₂) procedure had within 6 months (≤ 6 months) or beyond (> 6 months), and across PRO domains. Linear regression examined effects of TKA procedures on PRO improvement, adjusting for covariates including baseline PRO scores, demographic and clinical characteristics

Results

- Analyses included 3,124 unilateral, 109 SimBTKA, 276 StaBTKA_{1/2} ≤ 6 months, 857 StaBTKA_{1/2} > 6 months patients. Unilateral patients had a mean (SD) age of 67.6 (8.1) years, BMI of 27.7 (4.9), and 31.9% were male. No differences in gender, ethnicity, or BMI were observed across TKA procedures ($P > 0.05$), except for age. Patients underwent unilateral TKA were older than other procedures, but younger than StaBTKA₂ > 6 months ($P < 0.05$). Most improvements were reached by 6 months (91% followed up), followed.
- At 6-month, the largest improvements were in pain (83.6%; $\delta = 0.79$), followed by physical function (64.0%; 0.56), daily activities (55.5%; 0.53), self-care (47.3%; 0.42), and mental health (13.8%; 0.06).
- SimBTKA patients experienced the greatest improvement (85.5%; Cliff's $\delta = 0.80$), followed by StaBTKA₂ ≤ 6 months (74.5%; 0.69), unilateral (70.1%; 0.65), StaBTKA₂ > 6 months (67.6%; 0.63), StaBTKA₁ ≤ 6 months (66.0%; 0.60), and StaBTKA₁ > 6 months (62.7%; 0.59) (Table 1).
- After adjusting for covariates, compared to unilateral, SimBTKA ($\beta = 0.34$), StaBTKA₂ ≤ 6 months ($\beta = 0.20$) and StaBTKA₂ > 6 months ($\beta = 0.09$) showed greater improvement, while StaBTKA₁ ≤ 6 months ($\beta = -0.15$) and StaBTKA₁ > 6 months ($\beta = -0.16$) improved less (Table 2).

Table 1 Mean improvement of 20 PROs-items compared across TKA procedures

TKA procedure	N (EQ-5D-5L, OKS, KSS)		Mean (SD) preop IS across PROs		Mean (SD) PRO-change metrics across PROs					Rank	
	Preop	6-month	Mean-based IS ^a	Median-based IS ^b	Improved Proportion, % ^c	Cliff's Delta ^f	Mean-based ISC ^c	Median-based ISC ^d	Preop IS (W-B)	Improve (L-S)	
Unilateral	417, 986, 3124	316, 847, 2851	2.91 (0.88)	2.80 (1.20)	70.14	0.65 (0.24)	1.42 (0.72)	1.70 (1.22)	4	3	
SimBTKA	9, 29, 105	4, 21, 86	2.81 (0.85)	2.60 (0.95)	85.46	0.80 (0.23)	1.80 (0.79)	2.12 (1.06)	2/1	1	
StaBTKA ₁ ≤ 6 M	21, 55, 275	19, 53, 259	2.77 (0.85)	2.75 (1.17)	65.98	0.61 (0.29)	1.41 (0.82)	1.67 (1.27)	1/2	5	
StaBTKA ₁ > 6 M	5, 112, 856	4, 112, 836	2.88 (0.85)	2.90 (1.13)	62.66	0.59 (0.34)	1.33 (0.87)	1.42 (1.24)	3	6	
StaBTKA ₂ ≤ 6 M	34, 56, 273	25, 45, 249	3.00 (0.94)	2.93 (1.11)	74.50	0.69 (0.25)	1.55 (0.79)	1.79 (1.12)	5	2	
StaBTKA ₂ > 6 M	95, 292, 856	74, 263, 809	3.10 (0.87)	3.07 (1.01)	67.63	0.63 (0.23)	1.33 (0.67)	1.65 (1.02)	6	4	

a. Mean of mean-based IS: Mean (SD) of item scores (IS) across items, IS calculated using the mean of each item score. E.g., Each item's mean score was first calculated across all patients; these 20-item means were then averaged; b. Mean of median-based IS: Mean (SD) of item scores (IS) across items, IS calculated using the median of each item score; c. Mean of mean-based IS change (ISC): Mean (SD) of ISC across items, ISC calculated using the difference in mean scores from preoperative to 6-month. E.g., For each item, the mean score at 6 months subtracted the preoperative mean score to calculate item-level change; these 20 changes were then averaged to obtain the overall ISC; d. Mean of median-based IS change: Mean (SD) of ISC across items, ISC calculated using the difference in median scores from preoperative to 6-month; e. Mean of proportion of improvement averaged across items; f. Mean of Cliff's delta averaged across items; W-B: worst to best; L-S: largest to smallest.

Table 2 Regression coefficients of TKA procedures compared with unilateral TKA for 20 PRO-items

Instrument	PRO-items	N (surgery)	N (patient)	Coefficients (SE), with unilateral TKA as reference				
				SimBTKA	StaBTKA ₁ ≤ 6 M	StaBTKA ₁ > 6 M	StaBTKA ₂ ≤ 6 M	StaBTKA ₂ > 6 M
KSS	Walking	5077	4045	0.276** (0.084)	-0.073 (0.049)	-0.054 (0.030)	0.010 (0.050)	0.065* (0.030)
	Stairs up and down	5073	4048	0.129 (0.077)	-0.158*** (0.044)	-0.028 (0.027)	0.089* (0.045)	0.082** (0.027)
OKS	Pain	5047	4030	0.128 (0.081)	0.109* (0.047)	0.082** (0.029)	0.128** (0.048)	0.038 (0.029)
	Pain description	1332	1195	0.424 (0.244)	0.073 (0.145)	0.047 (0.103)	0.381* (0.154)	0.096 (0.074)
EQ-5D-3L	Washing dressing	1338	1201	0.113 (0.085)	0.035 (0.050)	-0.012 (0.034)	0.039 (0.053)	0.031 (0.025)
	Transportation	1340	1203	0.282 (0.148)	0.104 (0.088)	0.013 (0.061)	0.162 (0.093)	0.040 (0.044)
	Pain walking minutes	1339	1201	0.396* (0.171)	0.047 (0.102)	0.058 (0.072)	0.219* (0.108)	0.026 (0.051)
	Pain stand-up	1335	1197	0.317* (0.132)	0.095 (0.078)	0.111* (0.054)	0.190* (0.082)	0.069 (0.039)
	Limping walking	1338	1200	0.151 (0.260)	-0.224 (0.154)	0.109 (0.108)	0.342* (0.163)	0.088 (0.078)
	Kneel and up	1339	1202	-0.221 (0.264)	-0.004 (0.156)	-0.033 (0.112)	0.195 (0.167)	0.017 (0.079)
	Pain at night	1334	1197	0.207 (0.167)	-0.077 (0.099)	0.004 (0.070)	0.158 (0.105)	0.084 (0.050)
	Pain interferes with work	1333	1197	0.250 (0.148)	0.015 (0.085)	0.059 (0.060)	0.179 (0.091)	0.052 (0.043)
	Feel knee give away	1338	1200	-0.051 (0.092)	0.020 (0.054)	0.020 (0.036)	-0.039 (0.057)	0.011 (0.027)
	Household shopping	1339	1201	0.195 (0.179)	0.054 (0.106)	0.025 (0.073)	0.113 (0.113)	0.036 (0.054)
	Climb one flight of stairs	1338	1200	0.414* (0.185)	0.124 (0.106)	0.008 (0.072)	0.288* (0.112)	0.134* (0.054)
	Mobility	436	422	1.023* (0.480)	-0.822*** (0.212)	-1.358** (0.453)	0.423* (0.192)	0.294* (0.121)
	Self-care	437	423	0.342 (0.308)	-0.170 (0.135)	0.190 (0.285)	0.161 (0.122)	0.134 (0.078)
	Usual activities	437	423	1.067* (0.495)	-0.785*** (0.219)	-1.303** (0.467)	0.477* (0.198)	0.184 (0.125)
	Pain/Discomfort	435	421	0.739 (0.555)	-1.379*** (0.255)	-0.840 (0.539)	0.454* (0.223)	0.200 (0.140)
	Anxiety/Depression	437	423	0.525 (0.341)	-0.032 (0.148)	-0.235 (0.319)	0.037 (0.133)	0.019 (0.084)
Averaged coefficients across 20 PROs				0.335	-0.152	-0.157	0.200	0.085
Statistically significant coefficients (N)				6	5	4	10	4

*p<0.05; **p<0.01, ***p<0.001; SimBTKA: simultaneous bilateral TKA; StaBTKA₁ ≤ 6 M, StaBTKA₂ ≤ 6 M: the first and second procedure of staged bilateral TKA had within or beyond 6-month interval; StaBTKA₁ > 6 M, StaBTKA₂ > 6 M: the first and second procedure of staged bilateral TKA had beyond 6-month interval.

Conclusion

Findings suggest post-TKA benefits were greater in physical than mental domains, and outcomes varied by procedures and timing, with SimBTKA and early staged procedures showing better results, when adjusting for available confounders, though residual confounding from unmeasured factors cannot be ruled out. Given ongoing debate in the literature about the risks (e.g., complications, readmissions) of SimBTKA versus StaBTKA, this study offers patient-centred insights to facilitate informed surgical decisions on TKA-procedure selection.