Early Aseptic Revisions have a Negative Impact on Patient-Reported Outcomes after Total Knee Arthroplasty

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INTRODUCTION: Even though technically challenging, total knee arthroplasty (TKA) has been associated with favorable clinical outcomes. However, even today, considerable share of TKAs develop mechanical complications, requiring aseptic revision. Notably, evidence on the impact of time from revision procedure to the primary TKA on the clinical outcomes, or if length of time actually determines rerevision rate or patient-reported outcome measures (PROMs) after aseptic revision is largely missing. Therefore, our objectives for this study were as follows: 1) to compare rerevision rate and clinical outcomes (readmissions and complications) between early (<3 years) and late (≥3 years) aseptic revisions after primary TKA, and 2) to evaluate differences in PROMs and mortality between the comparative groups.

METHODS: A retrospective review was conducted on a prospective institutional database established as a modified Research Electronic Data Capture (REDCap) system in our institution spanning seven hospitals. This database records all elective knee orthopaedic surgical procedures, and 713 patients who underwent aseptic revisions after primary TKAs were initially selected. Operations were performed by 27 surgeons from 08/17/2015 to 12/27/2018. The study inclusion criteria was the availability of dates of primary and revision TKAs to allow classification into study cohorts. Thus, 5 patients were excluded, and 708 patients were analyzed. Included patients were categorized into early aseptic TKA revision (<3 years) (n=238) and late aseptic TKA revision (≥3 years) (n=470) groups. Data collection included patient and surgical characteristics and clinical outcomes. Patient characteristics comprised age, gender, race, ethnicity, smoking status, insurance type, Charlson comorbidity index (CCI), and revision diagnosis. Also, operative time, extensor mechanism status, information on use of femoral or tibial cones/augments, length of stay (LOS), postoperative maximum knee flexion (degrees), complications, and discharge disposition (DD) were also collected. Outcome data involved rerevision (ipsilateral knee), 90-day readmissions, general health PROMs, and hip-specific PROMs and mortality. Medians and interquartile ranges were used for description of continuous variables, and were compared between early and late aseptic TKA revision groups using Wilcoxon rank-sum tests. The categorical variables were summarized and compared between early and late aseptic TKA revision groups using Chi-square tests or Fisher's exact tests. All tests are two-sided, assuming an alpha level of 0.05.

RESULTS: Baseline patient characteristics were not significantly different between early and late aseptic TKA revision groups, except for age and diagnosis (Table 1). Patients who had late aseptic TKA revision were significantly older than those who had an early revision (67 vs. 63 years; $p<0.001$). While significantly more late revisions (≥3 years) were performed to treat implant failure (24.5% vs. 10.1%), more patients were revised earlier (<3 years) to treat instability (31.1% vs. 18.5%) and miscellaneous (20.6% vs. 7.02%) complications. Operative time was significantly more in late TKA revisions (162min vs. 145min) but extensor mechanism status (intact vs. not), case complexity (use of femoral or tibial cones/augments), postoperative maximum knee flexion, LOS, complication rates, and DD did not show any differences between the groups. Furthermore, readmissions, rerevisions, and mortality rates were similar in late vs. early aseptic TKA revision cohorts (Table 2). Regarding PROMs, KOOS-PS and VR-12-MCS scores were significantly lesser in early aseptic revision TKA group (vs. late) at baseline. Significantly higher delta changes in KOOS-QoL and VR-12-PCS scores were seen in late aseptic revision TKA group (Table 3), reflecting in significantly higher KOOS-QoL and VR-12-PCS scores at postoperative 1-year follow up. In addition to these outcome measures, KOOS-Pain, KOOS-PS, and VR-12-MCS scores were also significantly greater in patients who had late aseptic revision TKA (Table 2).

DISCUSSION AND CONCLUSION: Our data suggests that the timeline of aseptic revision from primary TKA does matter, showing a significant impact on patient-reported outcome measures, with patients undergoing revision more than 3 years subsequent to the primary, experiencing lesser pain, higher quality of life, and better physical and mental functionality at 1 year after surgery.

Table 1. Demographics

Variable	Level	Total (N=708)	Aseptic TKA revision within 3 years of primary (N=238)	Aseptic TKA revision after 3 years of primary (N=470)	P-value	N
Age, Median [25th;75th]		66.0 [59.0;71.0]	63.0 [57.0;69.8]	67.0 [60.0;73.0]	<0.001	708
Sex, N (%)	Male	172 (37.1%)	54 (34.2%)	118 (38.6%)	0.409	464
	Female	292 (62.9%)	104(65.8%)	188 (61.4%)		
Race, N (%)	White	531 (78.9%)	169(76.1%)	362 (80.3%)	0.241	673
	Other	16 (2.38%)	8 (3.60%)	8 (1.77%)		
	Black	126 (18.7%)	45 (20.3%)	81 (18.0%)		
Hispanic, N (%)	No	423 (94.4%)	136(91.3%)	287 (96.0%)	0.067	448
	Yes	25 (5.58%)	13 (8.72%)	12 (4.01%)		
Diagnosis, N (%)	Implant failure	139 (19.6%)	24 (10.1%)	115 (24.5%)	<0.001	708
	Aseptic loosening	276 (39.0%)	77 (32.4%)	199 (42.3%)		
	Bone related	50 (7.06%)	14 (5.88%)	36 (7.66%)		
	Instability	161 (22.7%)	74 (31.1%)	87 (18.5%)		
	Other	82 (11.6%)	49 (20.6%)	33 (7.02%)		
CCI, Median [25th;75th]		0.00 [0.00;1.00]	0.00 [0.00;1.00]	0.00 [0.00;1.00]	0.821	708
BMI, Median [25th;75th]		32.1 [27.9;37.1]	32.2 [28.2;37.5]	31.9 [27.8;36.6]	0.710	563
Insurance, N (%)	Medicare	212 (46.3%)	69 (44.5%)	143 (47.2%)	0.456	458
	Medicaid	21 (4.59%)	5 (3.23%)	16 (5.28%)		
	Non-Medicare/Medicaid	225 (49.1%)	81 (52.3%)	144 (47.5%)		
Smoking, N (%)	Never	353 (54.2%)	114(52.3%)	239 (55.2%)	0.887	651
	Quit 6+ months ago	216 (33.2%)	74 (33.9%)	142 (32.8%)		
	Quit within 6 months	25 (3.84%)	9 (4.13%)	16 (3.70%)		
	Current smoker	57 (8.76%)	21 (9.63%)	36 (8.31%)		
Laterality, N (%)	Left	359 (50.7%)	115(48.3%)	244 (51.9%)	0.451	708
	Right	347 (49.0%)	122(51.3%)	225 (47.9%)		
Extensor mechanism intact, N (%)	No	35 (4.96%)	15 (6.33%)	20 (4.26%)	0.313	706
	Yes	671 (95.0%)	222(93.7%)	449 (95.7%)		
Femoral Cone, N (%)	No	285 (90.8%)	83 (93.3%)	202 (89.8%)	0.457	314
	Yes	29 (9.24%)	6 (6.74%)	23 (10.2%)		
Tibial Cone, N (%)	No	158 (54.7%)	46 (56.8%)	112 (53.8%)	0.749	289
	Yes	131 (45.3%)	35 (43.2%)	96 (46.2%)		
Femoral Augment, N (%)	No	168 (37.1%)	54 (39.7%)	114 (36.0%)	0.516	453
	Yes	285 (62.9%)	82 (60.3%)	203 (64.0%)		
Tibial Augment, N (%)	No	272 (63.3%)	88 (67.2%)	184 (61.5%)	0.314	430
	Yes	158 (36.7%)	43 (32.8%)	115 (38.5%)		

Table 2. Surgical characteristics, outcomes and patient reported outcome measures (PROMs)

Variable	Level	Total (N=708)	Aseptic TKA revision within 3 years of primary (N=238)	Aseptic TKA revision after 3 years of primary (N=470)	P- value	N
Surgery Duration (minutes), Median [25th;75th]		158 [116;202]	145 [111;192]	162 [122;206]	0.003	707
LOS, Median [25th;75th]		2.00 [2.00;3.00]	2.00 [2.00;3.00]	2.00 [2.00;3.00]	0.503	708
Max Flexion, Median [25th;75th]		120 [100;130]	120 [100;130]	120 [100;130]	0.618	708
Complication, N (%)	No	695(98.4%)	236 (99.6%)	459 (97.9%)	0.110	706
	Yes	11 (1.56%)	1 (0.42%)	10 (2.13%)		
Discharge Disposition, N (%)	Home/Home Health	364(78.6%)	129 (81.6%)	235 (77.0%)	0.306	463
	Non-Home	99 (21.4%)	29 (18.4%)	70 (23.0%)		
90-day Readmission, N (%)	No	608(92.3%)	203 (93.5%)	405 (91.6%)	0.477	659
	Yes	51 (7.74%)	14 (6.45%)	37 (8.37%)		
Deceased, N (%)	No	706(99.7%)	238 (100%)	468 (99.6%)	0.553	708
	Yes	2 (0.28%)	0 (0.00%)	2 (0.43%)		
Complication Type Fracture, N (%)	No	696(98.6%)	236 (99.6%)	460 (98.1%)	0.177	706
	Yes	10 (1.42%)	1 (0.42%)	9 (1.92%)		
Complication Type Vascular injury, N (%)	No	706 (100%)	237 (100%)	469 (100%)	.	706
Complication Type Nerve injury, N (%)	No	706 (100%)	237 (100%)	469 (100%)	.	706
Complication Type Tendon injury, N (%)	No	706 (100%)	237 (100%)	469 (100%)	.	706
Baseline KOOS-Pain, Median [25th;75th]		38.9 [25.0;47.2]	36.1 [25.0;46.3]	38.9 [25.0;50.0]	0.113	651
Baseline KOOS- PS, Median [25th;75th]		48.8 [33.4;56.0]	45.6 [33.4;56.0]	48.8 [38.0;56.0]	0.008	647
Baseline KOOS-QoL, Median [25th;75th]		12.5 [0.00;31.2]	12.5 [0.00;25.0]	12.5 [6.25;31.2]	0.053	651
Baseline VR-12 PCS, Median [25th;75th]		25.9 [21.4;31.4]	25.7 [21.3;30.2]	25.9 [21.6;32.0]	0.472	650
Baseline VR-12 MCS, Median [25th;75th]		45.9 [36.0;56.4]	43.5 [33.8;53.3]	46.8 [37.0;57.3]	0.018	650
Baseline HSS Pedi-FABS, Median [25th;75th]		1.00 [0.00;7.00]	1.00 [0.00;6.00]	2.00 [0.00;7.50]	0.494	65
1-Year KOOS-Pain, Median [25th;75th]		72.2 [52.8;91.7]	63.9 [47.2;83.3]	75.0 [55.6;91.7]	<0.001	469
1-Year KOOS-PS, Median [25th;75th]		64.7 [53.9;78.0]	61.4 [48.8;72.5]	66.4 [58.0;78.0]	<0.001	441
1-Year KOOS-QoL, Median [25th;75th]		50.0 [25.0;68.8]	37.5 [16.7;62.5]	50.0 [31.2;75.0]	<0.001	472
1-Year VR-12 PCS, Median [25th;75th]		36.5 [26.7;44.9]	32.9 [23.9;41.9]	38.0 [28.7;46.9]	<0.001	477
1-Year VR-12 MCS, Median [25th;75th]		53.7 [42.2;60.6]	51.7 [38.0;59.7]	54.2 [44.7;61.4]	0.007	477
1-Year HSS Pedi-FABS, Median [25th;75th]		4.00 [0.00;9.00]	3.00 [0.00;9.50]	4.00 [0.00;9.00]	0.802	61

Table 3. Delta changes in PROMs from baseline to 1-year follow-up.

Variable	Total (N=708)	Aseptic TKA revision within 3 years of primary (N=238)	Aseptic TKA revision after 3 years of primary (N=470)	P-value	N
KOOS-Pain delta, Median [25th;75th]	30.5 [13.9;47.2]	27.8 [8.34;47.2]	30.6 [16.7;50.0]	0.063	469
KOOS-PS delta, Median [25th;75th]	19.1 [5.50;31.3]	18.9 [4.90;29.5]	19.1 [6.70;33.0]	0.318	438
KOOS-QOL delta, Median [25th;75th]	25.0 [12.0;50.0]	18.8 [6.25;43.8]	31.2 [12.5;50.0]	0.009	472
VR-12 PCS delta, Median [25th;75th]	8.77 [1.14;16.5]	6.42 [0.66;15.7]	9.75 [2.24;16.9]	0.035	476
VR-12 MCS delta, Median [25th;75th]	3.35 [-4.94;11.6]	1.68 [-6.05;11.3]	3.78 [-4.08;11.6]	0.459	476
HSS Pedi-FABS delta, Median [25th;75th]	0.00 [-3.00;3.00]	0.00 [-1.50;1.50]	2.00 [-2.75;3.50]	0.831	25