Establishing Diagnosis-Specific Measures of Clinical Significance for KOOS Scores in Aseptic Revision TKA: A Prospective Cohort of 1,223 Patients

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INTRODUCTION: As the number of TKA procedures continues to grow, the incidence of revision surgeries is also expected to increase. The minimal clinically important difference (MCID), patient acceptable symptom state (PASS), and substantial clinical benefit (SCB) are valuable metrics for assessing the success of these procedures, but their thresholds can differ significantly based on patient characteristics and methodology. While these thresholds have been established for primary TKA, they remain unclear in the revision setting, particularly when considering the influence of the revision diagnosis. Furthermore, there is limited evidence on the impact of the diagnosis on revision TKA thresholds. This study aimed to establish MCID, PASS, and SCB thresholds for the Knee Injury and Osteoarthritis Outcome Score (KOOS) Pain, KOOS PS, and KOOS JR, stratified by aseptic revision TKA (rTKA) diagnosis, including implant failure, aseptic loosening, instability, and periprosthetic bone fracture.

METHODS: A prospective institutional cohort of 1,223 patients who underwent revision TKA between January 2016 and December 2022 was included. Of these, 1,039 (85%) completed baseline patient-reported outcome measures (PROMs), and 752 (62%) completed one-year follow-up. Demographics, comorbidities, baseline, and one-year KOOS Pain, PS, and JR scores were recorded. Patients were stratified by aseptic rTKA diagnosis: implant failure (n=93), aseptic loosening (n=313), instability (n=320), and periprosthetic bone fracture (n=26). (Table 1) MCID values were determined using a distribution-based approach (half standard deviation of change scores), while PASS values were established using an anchor-based method based on patient satisfaction at one year. SCB was evaluated using an anchor question comparing current physical health to the previous year.

RESULTS: MCID thresholds for KOOS Pain ranged from 8.50 (aseptic loosening) to 10.99 (periprosthetic fracture), with 76-92% of patients achieving MCID. For KOOS PS, MCID thresholds ranged from 8.83 (instability) to 12.03 (periprosthetic fracture), with 64-75% of patients achieving MCID. (Table 2) KOOS JR MCID thresholds ranged from 7.70 (aseptic loosening) to 9.79 (periprosthetic fracture), with 71-86% of patients achieving MCID. SCB thresholds for KOOS Pain ranged from 30.55 (instability) to 44.45 (periprosthetic fracture), with 41-62% of patients achieving SCB. (Table 3)For KOOS PS, SCB thresholds ranged from 13.3 (implant failure) to 26.2 (aseptic loosening), with 33-52% of patients achieving SCB. KOOS JR SCB thresholds ranged from 11.76 (instability) to 42.04 (periprosthetic fracture), with 15-54% of patients achieving SCB. PASS thresholds for KOOS Pain ranged from 62.50 (implant failure) to 80.56 (periprosthetic fracture). The percentage of patients achieving PASS for KOOS Pain ranged from 50% (instability) to 77% (periprosthetic fracture). For KOOS PS, PASS thresholds ranged from 58.0 (periprosthetic fracture) to 63.0 (aseptic loosening). The percentage of patients achieving PASS for KOOS PS ranged from 53% (instability) to 73% (periprosthetic fracture). KOOS JR PASS thresholds ranged from 59.38 (aseptic loosening) to 76.33 (periprosthetic fracture). The percentage of patients achieving PASS for KOOS JR ranged from 44% (instability) to 59% (implant failure). (Table 4)

DISCUSSION AND CONCLUSION: There is substantial variability in clinically important PROMs thresholds (KOOS - MCID, PASS, and SCB) depending on the indication for rTKA, highlighting the necessity of taking these factors into account when assessing patient outcomes and satisfaction following rTKA. Notably, periprosthetic fracture consistently showed the highest MCID and PASS thresholds across all PROMs, while instability had the lowest proportion of patients reaching PASS for KOOS Pain and KOOS JR. These results provide valuable insights for clinicians to manage patient expectations more effectively and to develop tailored rehabilitation strategies based on the unique challenges associated with each revision diagnosis.

Table 1. Baseline and 1-year PROMs

Variable	Level	All (n=752)	Aseptic Loosening (n=313)	Implant Failure (n=93)	Instability (n=320)	Periprosthetic Fracture (n=26)	P-value	N
Baseline KOOS-Pain		38.9 [27.8;50.0]	36.1 [27.8;47.2]	41.7 [30.6;53.6]	38.9 [27.8;47.2]	37.5 [28.5;55.6]	0.116	752
Baseline KOOS-PS		48.8 [38.0;58.0]	48.8 [33.4;56.0]	53.9 [42.1;61.4]	51.5 [38.0;58.0]	48.8 [42.1;63.0]	0.067	750
Baseline KOOS-JR		44.9 [34.2;52.5]	42.3 [34.2;52.5]	47.5 [38.3;57.1]	44.9 [34.2;52.5]	44.9 [35.6;57.1]	0.097	678
Baseline MCS		48.0 [37.6;58.0]	47.3 [37.3;58.8]	51.5 [41.8;58.3]	47.6 [37.4;57.5]	46.5 [30.9;55.3]	0.258	752
1-Year KOOS-Pain		72.2 [52.8;91.7]	75.0 [52.8;93.8]	86.1 [63.2;97.2]	66.7 [50.0;83.3]	91.7 [82.3;97.2]	**<0.00 1**	744
1-Year KOOS-PS		64.7 [53.9;78.0]	66.4 [56.0;78.0]	71.4 [60.1;83.2]	62.2 [51.5;72.5]	75.1 [61.8;85.2]	**<0.00 1**	707
1-Year KOOS-JR		66.0 [52.5;79.9]	68.3 [52.5;79.9]	73.3 [59.4;79.9]	61.6 [50.0;73.3]	79.9 [68.3;79.9]	**<0.00 1**	624
1-Year MCS		53.4 [43.1;66.3]	53.8 [44.6;60.7]	55.6 [44.6;61.2]	51.1 [40.3;60.0]	52.5 [47.8;59.9]	0.173	747
PASS		456 (62.3%)	204 (67.8%)	62 (67.4%)	169 (54.2%)	21 (84.0%)	**<0.00 1**	730
Pain Difference		30.6 (24.2)	33.0 (24.0)	34.5 (22.5)	25.8 (23.9)	46.9 (22.7)	**<0.00 1**	744
PS Difference		17.2 [5.65;29.9]	19.1 [6.70;33.6]	19.2 [8.30;33.2]	14.9 [4.10;26.5]	19.1 [13.7;37.1]	**0.038**	706
JR Difference		20.5 [7.95;34.1]	23.1 [10.00;37.1]	21.8 [11.2;34.8]	17.9 [6.68;28.7]	31.1 [20.8;40.3]	**0.004**	624

Table 2. MCID KOOS pain, PS, and JR thresholds stratified by rTKA diagnosis

Variable	MCID	Pct_MCID
Pain Aseptic Loosening	8.50	83
Pain Implant Failure	10.41	87
Pain Instability	9.24	76
Pain Periprosthetic Fracture	10.99	92
PS Aseptic Loosening	9.25	68
PS Implant Failure	9.41	70
PS Instability	8.83	64
PS Periprosthetic Fracture	12.03	75
JR Aseptic Loosening	7.70	78
JR Implant Failure	8.27	77
JR Instability	7.88	71
JR Periprosthetic Fracture	9.79	86

Table 3. PASS KOOS pain, PS, and JR thresholds stratified by rTKA diagnosis

PASS KOOS Pain

subgroup	optimal_cutpoint	youden	sensitivity	specificity	AUC	prevalence	Percentage
Aseptic Loosening	65.63	0.692642	0.852216	0.840425	0.912362	0.685501	0.62
Implant Failure	62.50	0.605992	0.950819	0.655172	0.805822	0.677777	0.74
Instability	66.67	0.603705	0.779761	0.823943	0.879778	0.541935	0.50
Periprosthetic Fracture	80.56	0.309523	0.809523	0.500000	0.505952	0.840000	0.77

PASS KOOS PS

subgroup	optimal_cutpoint	youden	sensitivity	specificity	AUC	prevalence	Percentage
Aseptic Loosening	63.0	0.709968	0.841836	0.868131	0.912928	0.682926	0.57
Implant Failure	62.2	0.500000	0.870370	0.629629	0.805212	0.666666	0.62
Instability	61.4	0.551254	0.804878	0.746376	0.838625	0.543046	0.53
Periprosthetic Fracture	58.0	0.644736	0.894736	0.750000	0.861842	0.826087	0.73

PASS KOOS JR

subgroup	optimal_cutpoint	youden	sensitivity	specificity	AUC	prevalence	Percentage
Aseptic Loosening	59.381	0.670363	0.880239	0.790123	0.914652	0.673387	0.54
Implant Failure	61.583	0.553846	0.900000	0.653846	0.802692	0.657894	0.59
Instability	61.583	0.626666	0.793333	0.833333	0.872472	0.555555	0.44
Periprosthetic Fracture	76.332	0.647058	0.647058	1.000000	0.794117	0.850000	0.46

Table 4. SCB KOOS pain, PS, and JR thresholds stratified by rTKA diagnosis

SCB KOOS pain

subgroup	optimal_cutpoint	youden	sensitivity	specificity	AUC	prevalence	Percentage
Aseptic Loosening	33.33	0.491841	0.794871	0.696969	0.784317	0.440678	0.52
Implant Failure	33.33	0.530303	0.863636	0.666666	0.776170	0.400000	0.52
Instability	30.55	0.385889	0.658536	0.727272	0.742405	0.427083	0.41
Periprosthetic Fracture	44.45	0.366666	0.700000	0.666666	0.533333	0.769230	0.62

SCB KOOS PS

subgroup	optimal_cutpoint	youden	sensitivity	specificity	AUC	prevalence	Percentage
Aseptic Loosening	26.2	0.380541	0.602564	0.777777	0.738215	0.440678	0.35
Implant Failure	13.3	0.432900	0.857142	0.575757	0.695526	0.388888	0.52
Instability	22.6	0.370066	0.569575	0.809090	0.718680	0.427083	0.33
Periprosthetic Fracture	19.1	0.700000	0.700000	1.000000	0.766666	0.769230	0.50

SCB KOOS JR

subgroup	optimal_cutpoint	youden	sensitivity	specificity	AUC	prevalence	Percentage
Aseptic Loosening	16.316	0.460129	0.870129	0.590000	0.775883	0.435028	0.52
Implant Failure	18.633	0.500000	0.863636	0.636363	0.756198	0.400000	0.46
Instability	11.759	0.396695	0.835658	0.537037	0.750000	0.431578	0.54
Periprosthetic Fracture	42.035	0.400000	0.400000	1.000000	0.500000	0.769230	0.15