Establishing Minimal Clinically Important Differences and Substantial Clinical Benefit Thresholds for Various Objective Gait Metrics after Unicompartmental Knee Arthroplasty

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INTRODUCTION:

As wearable and sensor technologies gain traction in postoperative monitoring, gait analysis offers an increasingly valuable tool for assessing recovery following unicompartmental knee arthroplasty (UKA). However, interpreting the clinical relevance of objective gait data remains a challenge. While minimal clinically important differences (MCID) are widely used for patient-reported outcomes, limited data exist on MCID, substantial clinical benefit (SCB) and minimal detectable change (MDC) thresholds for objective gait measures in the UKA population. This study aimed to define these thresholds for gait speed, step count, step length, double support time, and walking asymmetry in patients undergoing UKA.

METHODS: A secondary analysis was performed on a longitudinal observational cohort of 314 patients who underwent UKA between 2019 and 2023. Gait metrics were collected from wearable and smartphone devices from preoperative through 1-year postoperative timepoints. Patients completed the EQ-5D-5L at corresponding timepoints, which was used as an anchor to calculate MCID and SCB using ROC-AUC analysis with Youden's Index. Distribution-based methods were also applied to calculate MCID, MDC□□, MDC□□, and MDC□□.

RESULTS:

Anchor-based MCID thresholds were 0.063 m/s for gait speed, 434 steps for step count, 0.025 m for step length, 0.7% for double support time, and 0.7% for walking asymmetry. Corresponding SCB thresholds were 0.063 m/s, 2,676 steps, 0.028 m, 0.9%, and 0.7%, respectively. Distribution-based MDC_{95} values were 0.076 m/s, 1,502 steps, 0.047 m, 0.027%, and 0.127%, respectively. At one year postoperatively, 76.2% of patients met the MCID for gait speed. The average change in gait speed across the cohort was 0.033 ± 0.11 m/s. No significant baseline differences were observed between patients who met the gait speed MCID and those who did not.

DISCUSSION AND CONCLUSION:

This study established MCID and SCB thresholds across several objective gait metrics, enhancing their clinical interpretability following UKA. Our findings suggest that gait speed thresholds in UKA patients are comparable to those in other arthroplasty populations, while clinically meaningful changes in step counts may be greater than those reported in healthy or non-surgical populations. These results support the integration of digital gait monitoring into postoperative care for UKA and highlight the need for further research across devices and analytic platforms.

Partial Knee Arthroplasty	Pre-op average	Post-op average	n	Average Change ± SD	Minimal Detectable Change			Minimal Clinically Important Change		Substantial Clinical Benefit
					MDC_{80}	MDC_{90}	MDC_{95}	Distribution-based	Anchor-based	Anchor-based
Gait speed (m/s)	1.014 ± 0.124	1.044 ± 0.199	206	0.033 ± 0.105	0.0497	0.0636	0.076	0.0526	0.0633	0.0633
Step count (average daily)	5809 ± 3208	6135 ± 3493	314	327 ± 2779	981	1257	1502	1355	434	0.0633
Step length (m)	.601 ± 0.053	0.607 ± 0.057	206	0.006 ± 0.04	0.030	0.039	0.047	0.022	0.025	2676
Double support time (%)	0.313 ± 0.016	0.312±0.02	202	-0.001 ± 0.016	0.0179	0.023	0.027	0.0077	0.0067	0.0276
Walking asymmetry (%)	0.103 ± 0.128	0.062 ± 0.061	161	-0.041 ± 0.115	0.083	0.106	0.127	0.057	0.0066	0.0088