

# Establishing Minimal Clinically Important Differences and Substantial Clinical Benefit Thresholds for Various Objective Gait Metrics after Total Hip Arthroplasty

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## INTRODUCTION:

With growing integration of wearables and sensors into orthopedic care, gait analysis offers an opportunity to objectively monitor recovery after total hip arthroplasty (THA). Yet, clinicians lack clearly defined thresholds for interpreting these data in a meaningful clinical context. Although minimal clinically important differences (MCID) are well established for patient-reported outcomes, there is a lack of data defining MCID, substantial clinical benefit (SCB), and minimal detectable change (MDC) for objective gait parameters in the THA population. This study aimed to establish these thresholds for gait speed, step count, step length, double support time, and walking asymmetry in patients undergoing THA.

## METHODS:

A secondary analysis of a longitudinal observational cohort of 726 patients who underwent primary THA between 2019 and 2023 were analyzed. Objective gait metrics were collected via wearables and smartphones in patients undergoing THA from pre-operative to 1-year post-operative. Patients completed the EQ-5D-5L pre-operatively through 1-year post-operative, and was used as an anchor for utilizing ROC-AUC with Youden's Index to calculate MCID and SCB. Distribution based methods were also applied to calculate MCID, MDC80, MDC90, and MDC95.

## RESULTS:

The MCID thresholds were 0.022 m/s for gait speed, 1,056 steps for step count, 0.025 m for step length, 0.7% for double support time, and 0.7% for walking asymmetry. Corresponding thresholds for substantial clinical benefit (SCB) were 0.063 m/s for gait speed, 2,676 steps for step count, 0.028 m for step length, 0.3% for double support time, and 4.8% for walking asymmetry. Distribution-based MDC95 values were 0.083 m/s, 358 steps, 0.051 m, 0.032%, and 0.140%, respectively. At one year postoperatively, 87.2% of patients met the MCID threshold for gait speed. The average change in gait speed across the cohort was  $0.06 \pm 0.11$  m/s. Among the clinical measures evaluated, only the EQ-5D-5L score demonstrated a significant baseline difference between patients who met the MCID for gait speed and those who did not.

## DISCUSSION AND CONCLUSION:

This study established thresholds for MCID and SCB across multiple objective gait metrics allowing interpretation of their clinical relevance. Threshold for changes in gait speed and step counts appear to vary from values reported in non-arthroplasty populations. These findings lay the groundwork for integrating digital gait monitoring into routine THA follow-up and support the development of remote recovery benchmarks to guide patient-centered care. Additional research to determine the MCID of gait metrics collected by other technologies following arthroplasty is needed.

Total Hip Arthroplasty	Pre-op average	Post-op average	n	Average Change $\pm$ SD	Minimal Detectable Change			Minimal Clinically Important Change		Substantial Clinical Benefit
					MDC <sub>80</sub>	MDC <sub>90</sub>	MDC <sub>95</sub>	Distribution-based	Anchor-based	
Gait speed (m/s)	1.00 $\pm$ 0.13	1.07 $\pm$ 0.13	358	0.064 $\pm$ 0.11	0.054	0.069	0.083	0.057	0.022	0.052
Step count (average daily)	5457 $\pm$ 3044	6379 $\pm$ 3736	726	882 $\pm$ 645	234	299	358	323	1056	1403
Step length (m)	0.584 $\pm$ 0.063	0.604 $\pm$ 0.060	357	0.018 $\pm$ 0.048	0.033	0.043	0.051	0.024	0.025	0.025
Double support time (%)	0.312 $\pm$ 0.013	0.309 $\pm$ 0.021	350	0.0038 $\pm$ 0.018	0.021	0.027	0.032	0.009	0.003	0.0087
Walking asymmetry (%)	0.110 $\pm$ 0.120	0.059 $\pm$ 0.084	274	-0.051 $\pm$ 0.111	0.091	0.117	0.140	0.064	0.0082	0.048