

**Early Achievement of a Distribution-Based MCID Predicts Long-Term Patient-Perceived Success Following Total Knee Arthroplasty**  
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**Background:** Patient-reported outcome measures (PROMs) have become integral to orthopedic practice, functioning as tools for clinical assessment, research, and increasingly for insurance reimbursement calculations. The Center for Medicare and Medicaid Services has mandated PROM collection for total joint procedures, with plans to incorporate this data into hospital payment structures by 2028 [1]. Understanding clinically meaningful improvement requires quantification through minimum clinically important difference (MCID) thresholds, which define the absolute minimum increase in scores required for patients to perceive meaningful improvement in their condition. Anchor-based MCID thresholds are considered the gold standard because they directly incorporate patient perspectives through secondary anchoring questionnaires, establishing associations between patient-reported meaningful improvement and corresponding primary questionnaire scores. However, while patient-directed, these measures require sophisticated statistical methods such as predictive modeling or ROC analysis to link score changes between these two questionnaires to meaningful patient outcomes. This approach is resource-intensive and frequently contributes to survey fatigue by requiring patients to complete multiple questionnaires at each visit. Distribution-based MCIDs have emerged as a pragmatic alternative, calculated through baseline statistical variability within cohorts and grounded in statistical methodology. These statistically validated thresholds define the minimum score improvements that represent the first signs of recovery unlikely to result from measurement error or chance variation. Despite their statistical foundation, distribution-based thresholds face persistent criticism for lacking clinical intuition and direct patient involvement, with their validity and clinical utility at detecting 'patient-perceived' improvement frequently questioned by practitioners. The literature has consistently demonstrated that distribution-based thresholds are substantially smaller in magnitude than validated anchor-based counterparts, adding to the skepticism over their validity [2]. We propose a fundamental reconceptualization of this discrepancy: rather than viewing these smaller improvements as clinically irrelevant, we hypothesize that distribution-based thresholds capture early biological recovery signals that precede conscious patient awareness. Failure to achieve these subtle early improvements may represent a fundamental breakdown in the recovery cascade, functioning as a sensitive predictor of long-term patient-perceived failure. This study examines whether failure to achieve a distribution-based MCID within the early postoperative period predicts long-term failure to attain anchor-based MCID thresholds following total knee arthroplasty (TKA).

**Methods:** This IRB approved retrospective cohort study was conducted at a single tertiary academic orthopedic institution, including all patients who underwent primary unilateral TKA for osteoarthritis between January 2021 and April 2023. Inclusion required completion of pre-operative KOOS-JR questionnaires within 180 days of surgery, with both early postoperative (8-31 days) and long-term ( $\geq 90$ -540 days) KOOS-JR evaluations. Patients were excluded for non-osteoarthritis diagnoses, bilateral procedures, revision arthroplasty within one year, or incomplete data. The distribution-based MCID threshold was defined as a  $\geq 7.5$ -point improvement from baseline, corresponding to half the standard deviation of baseline scores. The anchor-based MCID threshold was defined as a  $\geq 16$ -point improvement based on established literature thresholds from a highly comparable patient population [3]. Multivariable logistic regression analysis assessed the relationship between early distribution-based MCID failure and long-term anchor-based MCID failure, adjusting for age, BMI, sex, race, smoking status, marital status, discharge disposition, ASA classification, baseline KOOS-JR score, and surgical technique.

**Results:** In total, 858 patients met the inclusion criteria, with a median age of 68 years and 68.0% female representation. Within the early postoperative period of 8-31 days, 519 patients (60.5%) successfully achieved the distribution-based MCID threshold of  $\geq 7.5$  points improvement, while 339 patients (39.5%) failed to reach this recovery milestone. At long-term follow-up of 90+ days postoperatively, 643 patients (74.9%) achieved the anchor-based MCID threshold of  $\geq 16$  points improvement, indicating patient-perceived meaningful recovery, while 215 patients (25.1%) failed to attain this threshold. Among patients who failed to achieve an early distribution-based MCID, nearly half (153/339, 45.1%) also failed to achieve a long-term anchor-based MCID, whereas among patients who successfully achieved an early distribution-based MCID, only 11.9% (62/519) failed to achieve the long-term anchor-based threshold ( $P < 0.001$ ), representing a four-fold difference in long-term failure rates between early achievers and non-achievers (Table 1). Multivariable regression analysis, adjusting for all demographic, clinical, and surgical variables, identified early distribution-based MCID failure as the most powerful predictor of long-term patient-perceived failure, with patients who failed to achieve early distribution-based MCID demonstrating more than triple the odds of failing to reach an anchor-based threshold at 90+ days (OR: 3.02; 95%CI: 2.03–4.53;  $P < 0.001$ ). Additional significant predictors of long-term poor patient-perceived outcomes included higher baseline KOOS-JR scores (OR: 1.07 per point; 95%CI: 1.05–1.10;  $P < 0.001$ ) and Black or African American race (OR: 2.01; 95%CI: 1.21–3.34;  $P < 0.01$ ).

**Discussion:** Distribution-based MCID thresholds have been criticized for relying on statistical variability rather than patient perspective, leading to their dismissal as insufficient markers of meaningful change. However, our findings suggest these measures may capture early biological improvement that precedes patient conscious awareness and may be early signs of patient perceived outcomes. In our cohort, patients failing to achieve distribution-based MCID within 8-31 days demonstrated an over three-fold increased odds of failing to reach an anchor-based MCID at  $\geq 90$  days, representing one of the strongest predictive relationships in TKA outcomes literature. This association surpassed traditional demographic and comorbidity predictors, reinforcing its clinical significance. The 8–31-day assessment window was selected based on research showing most patients achieve distribution-based improvements within 7-25 days postoperatively, when inflammatory responses subside and functional adaptation begins [4]. The  $\geq 90$ -day anchor-based assessment aligns with literature demonstrating that functional recovery plateaus by three months postoperatively. This temporal separation creates a 6–8-week predictive window where clinicians could implement targeted interventions before functional patterns become entrenched. These findings challenge traditional skepticism surrounding distribution-based MCIDs and suggest their utility as early predictive markers and real indicators of biological recovery. This approach may enable cost-effective identification of patients at risk for poor outcomes, addressing the persistent problem of TKA dissatisfaction. While validation in prospective, multicenter studies is needed, our results provide preliminary evidence for reconsidering the clinical value of distribution-based thresholds in TKA assessment.

**Clinical Relevance:** This study demonstrates that distribution-based MCID failure within 8-31 days post-TKA predicts poor long-term patient-perceived outcomes with greater accuracy than traditional risk factors. These findings provide clinicians with an early, cost-effective screening tool to identify high-risk patients and implement targeted interventions before recovery patterns become entrenched.

**References:** [1] Pasqualini I, Piuizzi NS. *J Bone Joint Surg Am.* 2024;106(13):1233-41. [2] Lyman S, et al. *Clin Orthop Relat Res.* 2018;476(12):2432-41. [3] Dekhne MS, et al. *Clin Orthop Relat Res.* 2024;482(4):688-98. [4] Maniar RN, et al. *Clin Orthop Relat Res.* 2019;477(1):41-6.

**Table 1.** Distribution-Based MCID Achievement (8–31 Days) vs. Anchor-Based MCID Outcomes ( $\geq 90$  Days)

Distribution-based MCID (8-31 days post-op)	Anchor-based MCID ( $\geq 90$ Days)		Total
	Achieved	Failed	
Achieved	457 (88.1%)	62 (11.9%)	519 (60.5%)
Failed	186 (54.9%)	153 (45.1%)	339 (39.5%)
<b>Total</b>	<b>643 (74.9%)</b>	<b>215 (25.1%)</b>	<b>858 (100%)</b>