

# One-Year Comparison of Smart Implant-Derived Gait Metrics and Patient-Reported Outcome Measures Following Primary Total Knee Arthroplasty

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**Introduction:** Total Knee Arthroplasty (TKA) is frequently performed to address advanced osteoarthritis, with patient-reported outcome measures (PROMs) traditionally guiding recovery assessments. While subjective evaluations provide useful insight, they may not fully capture functional progress. Smart implantable devices (SIDs) offer continuous, objective gait data, with 6 sub-metrics. The authors aim to evaluate TKA recovery utilizing SIDs and correlate the findings to traditional PROM’s.

**Methods:** We conducted a retrospective cohort study with 356 participants undergoing TKA using SID, at a sub-specialty hip and knee arthroplasty ASC (Cumming, GA). Eligible patients were aged 18 years or older with advanced osteoarthritis. Exclusion criteria included bilateral TKAs, joint infections, or neuromuscular disease. The SID continuously collected daily gait metrics, including step count, distance, walking speed, stride length, and cadence. PROMs included KOOS-JR, VR-12 PCS, and VR-12 MCS.

**Results:** Of the 356 participants, 135 patients provided continuous SID data over 12-months. At all postoperative time points from 6 weeks through 12 months, all SID-derived gait metrics demonstrated progressive improvement ( $p < .001$ ), with the exception of stride length, which showed a more modest gain ( $p = .05$ ). Similarly, PROMs including KOOS-JR and VR-12 PCS improved significantly over time ( $p < .001$ ).

**Discussion:** This study suggests that PROMs improve significantly post-TKA, and correlate with objective gait metrics, although weakly, which indicates a potential discrepancy between perceived recovery and functional improvement. SID gait metrics appear to provide a meaningful addition to traditional PROMs, offering an objective representation of physical capabilities. Integrating SID metrics may improve long-term functional outcomes, yet further studies are required to corroborate these findings across larger populations.

**Significance/Clinical Relevance:**

Continuous monitoring with SID provides an objective measure of functional recovery that complements PROMs, addressing limitations of patient self-reporting. Incorporating smart implant data into clinical practice may enhance long-term assessment and guide individualized rehabilitation after TKA.

**Keywords:** Total Knee Arthroplasty, Patient-Reported Outcome Measures, Recovery, Gait Metrics, Implantable Smart Devices

Metric	6W	12W	6M	1YR	p-value
Step Count (steps/d)	2,314.0 (1,168.0, 4,009.0)	3,277.0 (2,012.0, 5,064.0)	3,779.0 (2,398.0, 5,488.0)	4,465.0 (3,095.0, 6,858.0)	<0.001
Distance Traveled (Km)	1.74 (0.76, 2.94)	2.41 (1.48, 3.82)	2.85 (1.72, 4.49)	3.51 (2.14, 5.14)	<0.001
Functional Knee ROM (degrees)	52 (49, 55)	54 (51, 57)	55 (53, 58)	57 (54, 59)	<0.001
Walking Speed (m/s)	0.57 (0.47, 0.65)	0.61 (0.53, 0.69)	0.64 (0.56, 0.73)	0.66 (0.56, 0.74)	<0.001
Tibial ROM (degrees)	47 (42, 51)	49 (45, 53)	51 (47, 56)	53 (49, 57)	<0.001
Stride Length (m)	0.72 (0.63, 0.81)	0.74 (0.65, 0.84)	0.76 (0.65, 0.84)	0.77 (0.67, 0.87)	0.005
Cadence (steps/min)	86 (81, 92)	91 (85, 96)	94 (90, 100)	95 (91, 101)	<0.001

*Table 1. Descriptive statistics for smart implantable device (SID) gait metrics by postoperative timepoint*

Metric	Preop	6W	12W	6M	1YR	p-value
VR-12 MCS	56.9 (47.1, 63.2)	-	57.7 (50.9, 62.2)	59.5 (53.9, 62.9)	59.7 (54.3, 62.2)	0.003
VR-12 PCS	32.9 (27.1, 40.3)	-	41.2 (34.9, 47.2)	44.5 (37.7, 52.0)	47.2 (39.6, 54.5)	<0.001
KOOS JR	54.8 (47.5, 63.8)	-	68.3 (61.6, 76.3)	73.3 (63.8, 79.9)	76.3 (68.3, 92.0)	<0.001
NRS Pain	5 (4, 7)	3 (2, 4)	2 (1, 3)	-	-	<0.001

*Table 2. Descriptive statistics for PROMs by postoperative timepoint*