One-Year Comparison of SID Gait Metrics and PROMs Following Primary TKA: A Follow-Up Study

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INTRODUCTION: Total knee arthroplasty (TKA) is commonly performed for advanced osteoarthritis, with recovery often evaluated using patient-reported outcome measures (PROMs). However, PROMs can be limited by recall bias, ceiling effects, and subjectivity. Smart implantable devices (SIDs) provide continuous, passive, and objective data on physical function, offering a promising complement to subjective metrics. Our previous study found weak correlations between PROMs and SID-derived gait metrics at 6 and 12 weeks postoperatively. This updated analysis expands follow-up to 6 months and 1 year in a larger cohort to assess whether earlier patterns persist.

METHODS: We conducted a retrospective cohort study of 256 patients aged ≥18 undergoing primary TKA with SID implantation at a high-volume ambulatory surgery center. Patients with bilateral TKAs, joint infections, or neuromuscular disorders were excluded. All patients received a tibial extension with embedded inertial measurement units transmitting daily gait data (step count, distance, speed, stride length, cadence, and functional ROM) via secure mobile platforms. PROMs included the KOOS JR and VR-12 PCS/MCS. SID and PROM data were collected at 6 weeks, 12 weeks, 6 months, and 1 year.

RESULTS: Of the 256 participants, 115 provided continuous SID data through 1 year, and 195 completed 6-month follow-up. KOOS JR scores were available for 227 participants at 1 year and 222 at 6 months. SID-derived gait metrics showed significant improvement from 6 weeks to 1 year ($p < 0.001$). PROMs also demonstrated significant gains over time ($p < 0.001$). However, correlations between SID-derived gait metrics and PROMs remained weak across all time points, even after adjusting for demographics.

DISCUSSION AND CONCLUSION: SID-derived gait metrics and PROMs reflect recovery but appear to assess distinct aspects of function. These updated results support earlier findings and highlight the potential of SIDs to complement PROMs. A prospective, multicenter study is warranted.

Characteristic	6W N = 256[1]	12W N = 256[1]	6M N = 256[1]	1YR N = 256[1]	p-value[2]
Cadence	85 (80, 91)	90 (84, 96)	93 (88, 99)	96 (90, 102)	**<0.001**
Distance Traveled	1.65 (0.75, 2.74)	2.14 (1.20, 3.53)	2.73 (1.65, 4.11)	3.23 (2.14, 4.94)	**<0.001**
Functional ROM	52.0 (49.0, 55.0)	53.0 (51.0, 56.0)	55.0 (53.0, 58.0)	57.0 (54.0, 59.0)	**<0.001**
Step Count	2,207 (1,136, 3,897)	2,864 (1,778, 4,594)	3,538 (2,398, 4,966)	4,092 (2,746, 6,377)	**<0.001**
Stride Length	0.71 (0.63, 0.79)	0.73 (0.64, 0.82)	0.76 (0.65, 0.84)	0.76 (0.68, 0.86)	**0.002**
Tibia ROM	47 (42, 50)	48 (44, 52)	51 (47, 55)	53 (48, 57)	**<0.001**
Walking Speed	0.54 (0.47, 0.64)	0.58 (0.52, 0.67)	0.63 (0.54, 0.73)	0.66 (0.55, 0.74)	**<0.001**

[1] Median (Q1, Q3)

[2] Kruskal-Wallis rank sum test

Table 1: Smart Implantable Device (SID) metrics at 6 weeks, 12 weeks, 6 months, and 1 year postoperatively, including cadence, distance traveled, functional range of motion (ROM), step count, stride length, tibia ROM, and walking speed. Summary statistics and p-values are reported for comparisons across timepoints.

Characteristic	Preop N = 256[1]	12W N = 256[1]	6M N = 256[1]	1YR N = 256[1]	p-value[2]
KOOS JR Score	52 (47, 62)	68 (62, 76)	73 (64, 80)	76 (68, 92)	**<0.001**
VR-12 Physical Component Score	31 (26, 39)	41 (34, 47)	45 (38, 51)	47 (39, 54)	**<0.001**
VR-12 Mental Component Score	55 (45, 63)	58 (51, 62)	59 (54, 63)	59 (54, 62)	**0.002**

[1] Median (Q1, Q3)

[2] Kruskal-Wallis rank sum test

Table 2: Patient-Reported Outcome Measures (PROMs) at preoperative, 12-week, 6-month, and 1-year timepoints, including the Knee Injury and Osteoarthritis Outcome Score for Joint Replacement (KOOS JR) and the Veterans RAND 12-Item Health Survey (VR-12), reported as physical and mental component scores. Summary statistics and p-values are reported for comparisons across timepoints.