Using Wearable Devices to Track Post-operative Recovery Trajectories in Total Knee Arthroplasty Patients

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INTRODUCTION: Wearable devices enable objective, remote monitoring of recovery after total knee arthroplasty (TKA), but variability in recovery trajectories is not well understood. This study evaluated whether postoperative recovery can be predicted preoperatively using demographics, comorbidities, and baseline activity levels.

METHODS: Seventy-five patients undergoing primary TKA were prospectively enrolled under Institutional Review Board approval. Daily step counts were recorded using a smartwatch for a minimum of 4 days within the 7 days prior to surgery and for 90 days postoperatively. Patients were stratified into tertiles based on mean preoperative step counts (least, moderate, and most active). Recovery trajectories were compared across groups using one-way ANOVA ($p < 0.05$).

RESULTS: Participants had a mean age of 69.1 years (standard deviation [SD] = 7.8); 48.0% were women. Mean body mass index (BMI) was 32.8 kg/m² (SD = 5.1) in the least active group, 29.8 kg/m² (SD = 5.6) in the moderately active group, and 29.9 kg/m² (SD = 3.7) in the most active group (Table 1). Preoperative daily steps averaged 1,071, 2,835, and 6,623, respectively. At two weeks, mean daily steps were 1,906 (SD = 1,395), 1,865 (SD = 1,634), and 4,870 (SD = 2,525) ($p < 0.001$). At 12 weeks, steps increased to 4,252 (SD = 3,723), 6,566 (SD = 3,178), and 6,253 (SD = 2,793) ($p = 0.12$) (Table 2). The least active group exceeded preoperative step count by two weeks postoperatively, the moderately active group exceeded preoperative step count by four weeks postoperatively, and the most active group did not return to baseline by 12 weeks (Figure 1).

DISCUSSION: Preoperative activity strongly predicts postoperative recovery patterns following TKA. Remote monitoring via wearable devices provides a practical method for tracking recovery, supporting patient engagement, and detecting deviations from expected progress.

SIGNIFICANCE/CLINICAL RELEVANCE: As TKA volume increases, trajectory analysis informed by baseline activity can enhance preoperative counseling and personalize recovery expectations. Continuous monitoring also allows early identification of delayed recovery, enabling timely intervention and tailored rehabilitation.

IMAGES AND TABLES:

Table 1. Baseline demographic and clinical characteristics among patients undergoing total knee replacement surgery by tertile of pre-operative step counts (n=75).

Characteristics	Least active (n=25)	Moderately (n=25)	Most active (n=25)	All (n=75)
Age, mean (SD), years	69.1 (8.9)	70.3 (7.1)	68.1 (7.5)	69.1 (7.8)
Women (%)	60.0	39.1	44.0	48.0
Body mass index, mean (SD), kg/m²	32.8 (5.1)	29.8 (5.6)	29.9 (3.7)	30.9 (5.0)
Charlson Comorbidity Index Score (%)				
0	48.0	45.8	56.0	50.0
1	36.0	45.8	44.0	41.9
≥2	16.0	8.3	0	8.1
SF-36 PCS score, mean (SD)	29.1 (8.4)	35.5 (10.4)	34.0 (7.2)	32.8 (9.1)
SF-36 MCS score, mean (SD)	57.1 (9.0)	57.6 (7.9)	55.5 (12.2)	56.7 (9.8)
KOOS scores for surgical knee, mean (SD)				
Pain	39.8 (15.1)	53.4 (16.4)	44.8 (17.3)	45.9 (17.0)
Activities of daily living	45.8 (17.4)	60.2 (17.3)	53.5 (22.3)	53.0 (19.8)
Quality of life	26.3 (15.9)	42.7 (20.8)	30.8 (17.3)	33.1 (19.2)
Total score	37.3 (14.8)	52.1 (17.0)	43.0 (17.4)	44.0 (17.3)

Table 2. Post-operative mean step counts by tertile of pre-operative step counts (n=75).

Steps count	Least active (n=25) Mean (SD)	Median	Moderately (n=25) Mean (SD)	Median	Most active (n=25) Mean (SD)	Median	All (n=75) Mean (SD)	Median	P-value
Pre-op	1,071 (475)	1,048	2,835 (583)	2,892	6,623 (2,237)	6,099	3,710 (2,805)	2,902	<0.001
Week 2	1,906 (1,395)	1,439	1,865 (1,634)	2,519	4,637 (2,525)	4,870	3,337 (2,336)	2,905	<0.001
Week 4	3,124 (2,196)	2,690	3,825 (2,091)	3,959	4,387 (2,492)	4,129	3,958 (2,326)	3,486	0.21
Week 8	3,440 (1,919)	2,998	4,983 (2,885)	4,364	6,414 (3,387)	6,397	5,117 (3,137)	4,193	0.01
Week 12	4,252 (3,119)	3,723	6,566 (3,178)	6,149	6,028 (2,793)	6,253	5,797 (3,088)	5,369	0.12

Figure 1. Mean daily step counts in the TKA peri-operative period by tertile of pre-operative step counts (n=75).