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Stride One in Gait & Mobility (Re)training:

Improving Recovery After TKA, THA, ACL & Achilles Tendon Surgery

Following joint surgery, the majority of patients report decreased pain and successful long-term results, but **recovery is unpredictable**, and most patients continue to exhibit muscle weakness in their lower limbs and functional limitations in comparison to similarly aged control individuals[1]. One month after a total knee replacement for example, muscle function was shown to be lowered by 20%-25% but one year later, it is **still lower than in healthy adults,** with reports of 18% slower walking speed and 51% slower stair climbing speed[2,3].

Habitual **movement compensations,** such as decreased peak surgical knee extension moments persist years after TKA, are linked to poorer recovery, and may influence contralateral osteoarthritis progression[4]. Gait compensation (e.g. **asymmetry**) remains similar from 3- to 6-months during a task requiring greater knee demand compared to overground walking post-TKA, despite improvements in self-report surveys[5].

Surgeons experience **inconsistencies in patient satisfaction** prediction. Patients often do not reach functional levels of healthy controls and present with persistent gait deviations[6,7,8].

Evidence suggests that **biofeedback in early postoperative rehabilitation** after TKA is effective in improving gait symmetry, reducing pain and increasing activity level[9]. Weight-bearing biofeedback training following TKA results in increased knee extension moments during gait and improved the times measured for the sit-to-stand tests[1]. The most common types of feedback used are visual feedback followed by audio feedback, with one study mentioning that audio was preferred by the patients as it was easier to handle. Overall, the large majority of feedback methods demonstrated a potential value for improving mobility and decreasing pain[6].

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In people with TKA sometimes partial weight bearing is prescribed per post-operative rehabilitation protocol. However, patients are **unable to perform a correct gait with low weight bearing instructions** without a smart insole with biofeedback and measuring system[10]. On the other hand, using biofeedback from a wireless insole sensor significantly improves the maximum peak load in patients with prescribed unrestricted weight bearing[11]. This suggests improved **compliance and confidence with weight bearing instructions**, a precondition for gait and mobility training.

Currently, most postoperative rehabilitation from TKA occurs in the outpatient setting or at home. This leads clinicians to rely on reports from outpatient physical therapy or subjective methods such as patient-reported outcomes measures (PROMs) to measure recovery. However, previous studies have outlined **concerns over the standardization of PROMs as the only measure of recovery**. For instance, when determining if patients accurately report distance walked, the mean magnitude of reporting error is 69% preoperatively and 93% postoperatively.

Providers should exercise caution when interpreting patient reported activity levels before and after TKA/THA[12]. Moreover, clinic visits to evaluate recovery have often been reduced to 4–6 weeks postoperatively, increasing the possibility for important landmarks of recovery to be missed. This raises the potential value of objective activity measurement and the consistent contact between patients and surgical teams that wearable devices offer following TKA[13,14].

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Assessment of gait quality using spatial-temporal gait parameters (STGP) has proven applications in measuring fall risk, monitoring postoperative changes in mobility, and optimizing treatment plans. Additionally, knee biomechanics early after knee replacement surgery predict abnormal gait patterns 12 months postoperatively[15,16,17].

Patients receiving feedback on gait parameters such as step counts have significantly higher mean daily step count by 43% in week 1, 33% in week 2, 21% in week 6, and 17% at 6 months. Commercial activity trackers with step count feedback are associated with **higher activity levels** after TKA/THA and may be a useful adjunct after surgery[18].

Post-operative care costs of lower limb arthroplasty account for 36% of the total episode of care costs. A platform for clinicians that allows them to view patient engagement, activity levels, and gait parameters demonstrated non-inferiority to traditional care models (no significant difference in 90-day mean flexion, 90-day mean single leg stance time, 90-day mean timed up and go time) and potential to **decrease postoperative costs** while improving patient engagement and communication with providers[19,20]. Mehta et al. showed that goal setting and connection to care teams significantly reduced rehospitalizations[21].

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What's next?

Reliable digital and real-time data on patients' gait quality that are accessible to both the surgeon and the patient may help with **steering the recovery process and improve patient satisfaction**[22,23,24,25,26,27,28].

Real-time gait analysis and biofeedback to immediately identify and correct asymmetries, weight-bearing issues, and compensatory patterns may result in data-driven adjustments to exercises, optimizing ROM and strength gains for faster, more effective recovery. Visual feedback and progress tracking increase motivation and adherence, leading to better long-term outcomes and satisfaction. Objective gait data for precise monitoring of patient progress allow for timely and evidence-based adjustments to rehabilitation protocols.

Wearables providing real-time gait feedback have the potential to **supplement or completely replace conventional rehabilitation regimens** by effectively tracking physical activity and enhancing patient participation after total knee arthroplasty. Intervention components, including step objectives, app-based patient interaction platforms, and patient-specific rehabilitation benchmarks, may help programs work better[29]. Self-directed rehabilitation with a wearable device linked to a smartphone app showed non-inferiority to standard rehabilitation following TKA[30,31]. A significant better motor performance (gait symmetry and single stance support) has been found when applying visual feedback gait training after TKA compared with conventional physical therapy[32].

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Wearable devices and smartphone apps are able to **increase physical activity following TKA**. Van der Walt et al. showed setting daily step goals and using wearable devices that provide step count feedback can significantly increase daily step count up to 6 months postoperatively[17].

Preoperative step count, change in step count, and postoperative step count can be used to **predict patient recovery**.

These findings suggest value in leveraging passively collected step data from patients before surgery. While more research needs to be done to set data-driven, individualized benchmarks, wearable data can be a clinically viable alternative to predict recovery outcomes and identify complications earlier[33,34]

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