OneStep

WHITE PAPER · JOINT REPLACEMENT

Tracking Gait Recovery After Total Hip and Knee Arthroplasty

Population recovery trajectories, surgeon-level benchmarks and the in-app versus background gait gap in 600 patients

ONESTEP RESEARCH | 2026 | ONESTEP.CO/RESOURCES

OneStep

COVER LETTER

RE Tracking Gait Recovery After Total Hip and Knee Arthroplasty: Population Recovery Trajectories and Surgeon-Level Benchmarks in 600 Patients

Every joint replacement now has a benchmark

OneStep's surgical dataset turns the question "is this patient recovering normally?" into a measurement rather than an impression.

600	100,000+	1,000,000+	15 weeks
THA and TKA patients with gait data	In-app walk measurements	Background walk measurements	Recovery window tracked

Hip patients pass their pre-surgery walking speed between week 3 and 4 and plateau around week 6; knee patients cross at week 6 and plateau by week 9. The same curves exist for nine gait parameters and can be drawn for a single surgeon's patients against the whole population, so variation in technique, protocol or case mix becomes visible in weeks rather than at the one-year PROM.

What the data makes possible

Benchmark a surgeon

Project one surgeon's recovery curves against the population to see whether outcomes sit within, above or below the standard of care.

Set expectations with patients

Give patients a data-driven recovery timeline for their surgery type, and show them where they are on it.

Catch the outlier early

A patient falling below the 25th percentile of recovery, or diverging after a complication, is visible on the chart long before the follow-up visit.

TWO WAYS TO MEASURE, TWO ANSWERS

Patients walk measurably better when they know they are being measured. Active in-app walks recover **weeks earlier** than passive background walks in everyday life. Programs that only look at supervised walks are seeing the best-case recovery, not the real one.

To learn how surgeons and rehabilitation teams use OneStep's recovery benchmarks, contact us at hello@onestep.co or through our contact form.

© 2026 OneStep

The full white paper follows.

WHITE PAPER · 2026

Tracking Gait Recovery After Total Hip and Knee Arthroplasty

Population recovery trajectories, surgeon-level benchmarks and the in-app versus background gait gap in 600 patients

OneStep Research Team
OneStep · Correspondence: info@onestep.co

ABSTRACT

Background. Gait analysis offers an objective measure of functional recovery after joint replacement, but has traditionally been limited to sparse clinic visits or gait laboratories. Smartphone-based measurement allows recovery to be tracked continuously, both during active walk tests and passively during everyday mobility.

Objective. To characterize gait recovery trajectories after total hip arthroplasty (THA) and total knee arthroplasty (TKA), establish population benchmarks normalized to pre-surgery values, compare surgeon-specific trajectories against the population, and compare active in-app walks with passive background walks.

Methods. Retrospective analysis of 600 patients (321 THA, 279 TKA) enrolled in OneStep between October 2022 and August 2024 who recorded gait data, comprising over 100,000 in-app and 1 million background measurements. Weekly means of nine gait parameters were expressed as change from each patient's pre-surgery value over 15 weeks. An earlier cohort (75 THA, 43 TKA, 20 weeks) was used to fit mathematical recovery models and quartile distributions of recovery.

Results. THA patients recovered faster than TKA patients across all nine parameters; walking speed exceeded its pre-surgery value at weeks 3–4 (THA, plateau at week 6) versus week 6 (TKA, plateau at week 9). Surgeon-level trajectories diverged from the population. Active in-app walks reached pre-surgery thresholds weeks earlier than background walks in both cohorts. Recovery followed a rapid initial phase and then slowed, best described for THA by an exponential model, stabilizing by weeks 10–15. Two case studies illustrate an exceptional recovery and a periprosthetic fracture.

Conclusions. Smartphone-based gait data provides objective recovery benchmarks that allow comparison between surgeries, surgeons and protocols, and makes individual deviations from the expected trajectory visible early. The gap between in-app and background walks shows that passive, real-life measurement captures a different and more conservative picture of recovery.

KEY POINTS

Question	What does gait recovery after THA and TKA look like at population scale, and can individual surgeons and patients be benchmarked against it?
Findings	In 600 patients, THA recovered faster than TKA in all nine gait parameters (walk speed back to baseline at week 3–4 versus week 6). Surgeon-specific curves differed from the population, in-app walks recovered weeks earlier than background walks, and recovery followed a rapid-then-slow pattern stabilizing by week 10–15.
Meaning	Continuous gait measurement gives surgeons and therapists a recovery benchmark for each surgery type, a way to compare protocols and outcomes, and an early signal when an individual patient falls off the expected path.

KEYWORDS total hip arthroplasty · total knee arthroplasty · gait recovery · recovery trajectory · benchmarks · surgeon comparison · background monitoring · smartphone

© 2026 OneStep · www.onestep.co

About this edition. This paper consolidates OneStep's joint replacement research. The population analysis, surgeon comparison, in-app versus background comparison and case studies are from the April 2025 paper (600 patients). Section 6 carries forward the recovery modelling and quartile analysis from the April 2023 benchmark paper (118 patients), which this document supersedes.

1 Introduction

Gait analysis plays a vital role in tracking recovery after surgery, offering detailed progress timelines and personalized trajectories for each patient. It serves as an objective measure of functional improvement and gives a more complete picture of rehabilitation progress than visit-based assessment alone. Nearly 1.44 million Americans underwent total joint replacement in 2021,[1] and a substantial share report limited functional improvement a year after TKA.[2]

Surgeons typically see patients at a few fixed intervals and have limited insight into daily progress between visits. OneStep's mobile application measures gait from a smartphone carried in the pocket, without a gait lab, both during actively recorded walk tests and passively in the background during everyday walking. The data is shared with the treating team, who can see exactly how each patient is performing.

This study aimed to help surgeons use OneStep's gait analysis to guide decision-making around recovery after THA and TKA: how surgery type and recovery timeline affect gait and mobility, how an individual surgeon's outcomes compare with the population, and how actively recorded walks differ from everyday walking.

2 Cohort

1,301 patients who underwent THA or TKA were enrolled in OneStep between October 2022 and August 2024. Of these, 600 recorded gait data and form the study cohort: 321 THA and 279 TKA (Table 1). The dataset includes over 100,000 in-app measurements and 1 million background walk measurements. Gait data was included for patients who recorded measurements both pre- and post-surgery and who had data for more than a single week.

Surgery	Total	Female	Male	Mean age (SD)	Range	<35	35–59	60+
THA	321	185 (58%)	136 (42%)	67.8 (8.8)	31–87	1	51 (16%)	268 (83%)
TKA	279	169 (61%)	109 (39%)	69.1 (7.6)	45–88	0	33 (12%)	246 (88%)

Table 1. Cohort. Patients with recorded gait data, by surgery type. One THA patient and one TKA patient had no recorded sex or age.

3 Post-THA and post-TKA trajectories

We examined longitudinal data from the two cohorts over 15 weeks following surgery. For each gait parameter, the weekly average change from the patient's pre-surgery value was computed. Using walk speed as the example (Figure 1), THA patients surpassed their pre-surgery speed between the 3rd and 4th week and plateaued around week 6. TKA patients crossed the pre-surgery threshold later, around week 6, and plateaued by week 9.

The same pattern held across cadence, single support, stance asymmetry, double support, step length, step length asymmetry, stride length, walk speed and stride width: THA patients show faster recovery trajectories than TKA patients across all gait parameters (Figure 2).

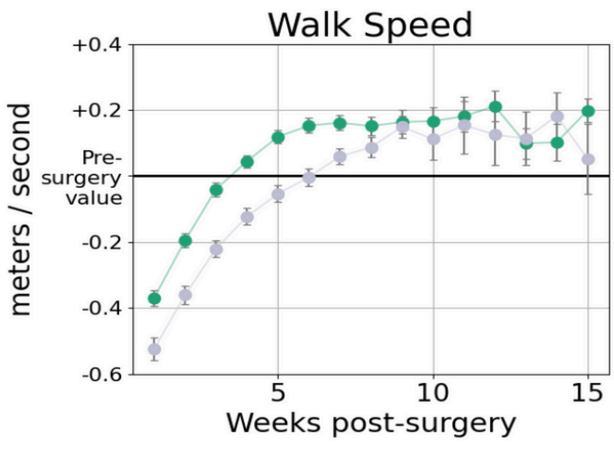


Figure 1. THA patients recover walk speed faster than TKA patients. Weekly mean change in walk speed from the pre-surgery value (black line) for THA (green) and TKA (grey). Error bars show standard error of the mean.

© 2026 OneStep · www.onestep.co

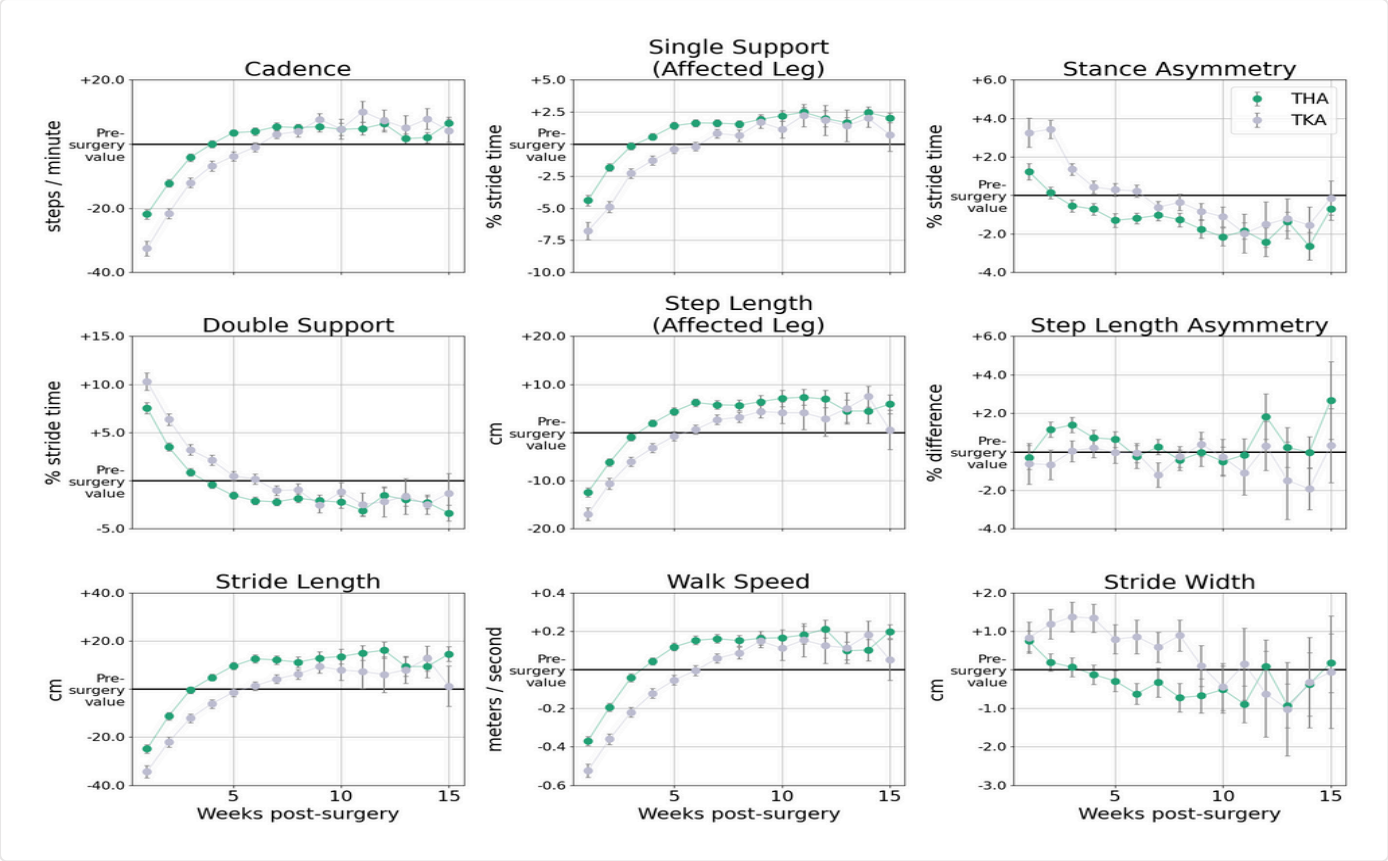


Figure 2. Faster recovery trajectories for THA patients across nine gait parameters. Weekly mean change from pre-surgery value for THA (green) and TKA (grey); error bars show standard error of the mean.

4 Surgeon-specific trajectories

Recovery trajectories can be calculated for any subgroup of patients. Grouping by surgeon and projecting that surgeon's THA and TKA patients against the entire population serves several purposes:

- **Benchmarking outcomes.** Assess quality of care and confirm that recovery times and complications fall within acceptable standards.
- **Identifying trends.** Highlight variation that may be unique to a surgeon's technique, approach or patient demographic.
- **Personalized care.** Give patients more accurate, personalized recovery predictions based on collective data.
- **Quality improvement.** Identify areas to improve, such as recovery speed or surgical technique, and promote accountability.
- **Patient expectations.** Set realistic, data-driven expectations for recovery timelines.

Figure 3 shows walk speed and stride length for one surgeon's THA patients (n = 5, data to week 7) against all THA patients. Comparing a single surgeon with the broader population helps assess whether performance, approach and patient management are within, above or below the average standard of care.

© 2026 OneStep · www.onestep.co

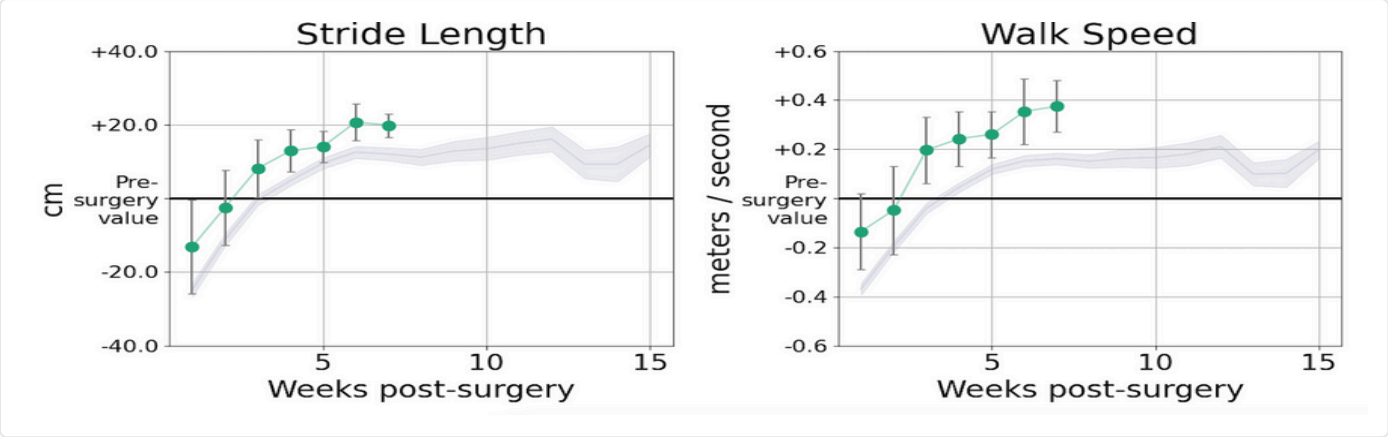


Figure 3. One surgeon versus the population. Stride length and walk speed recovery for THA patients of a single surgeon (green dots, n = 5, data to week 7) against the aggregated trajectory of all THA patients (grey band).

5 In-app versus background trajectories

OneStep measures gait in two ways. In-app measurements are conscious walks recorded actively by the patient; background measurements are recorded passively, without the patient initiating anything, as they move through their day. Active in-app measurements show faster recovery than background data across all gait parameters, in both THA (Figure 4) and TKA (Figure 5). In-app measurements reach the pre-surgery threshold weeks earlier than background measurements and plateau sooner.

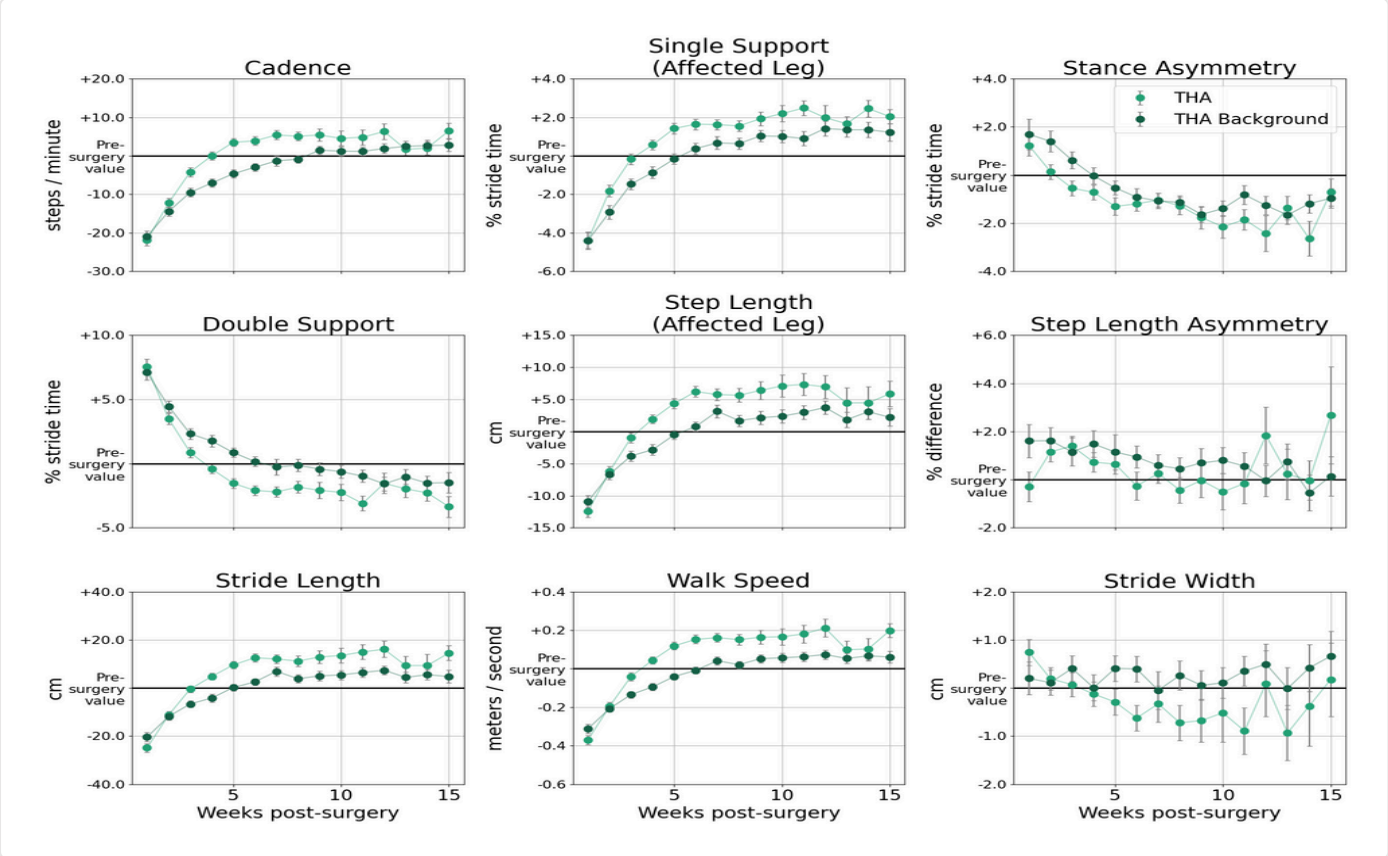


Figure 4. In-app versus background gait trends in THA. Nine gait parameters post-surgery; in-app active walks in light green, background measurements in dark green.

© 2026 OneStep · www.onestep.co

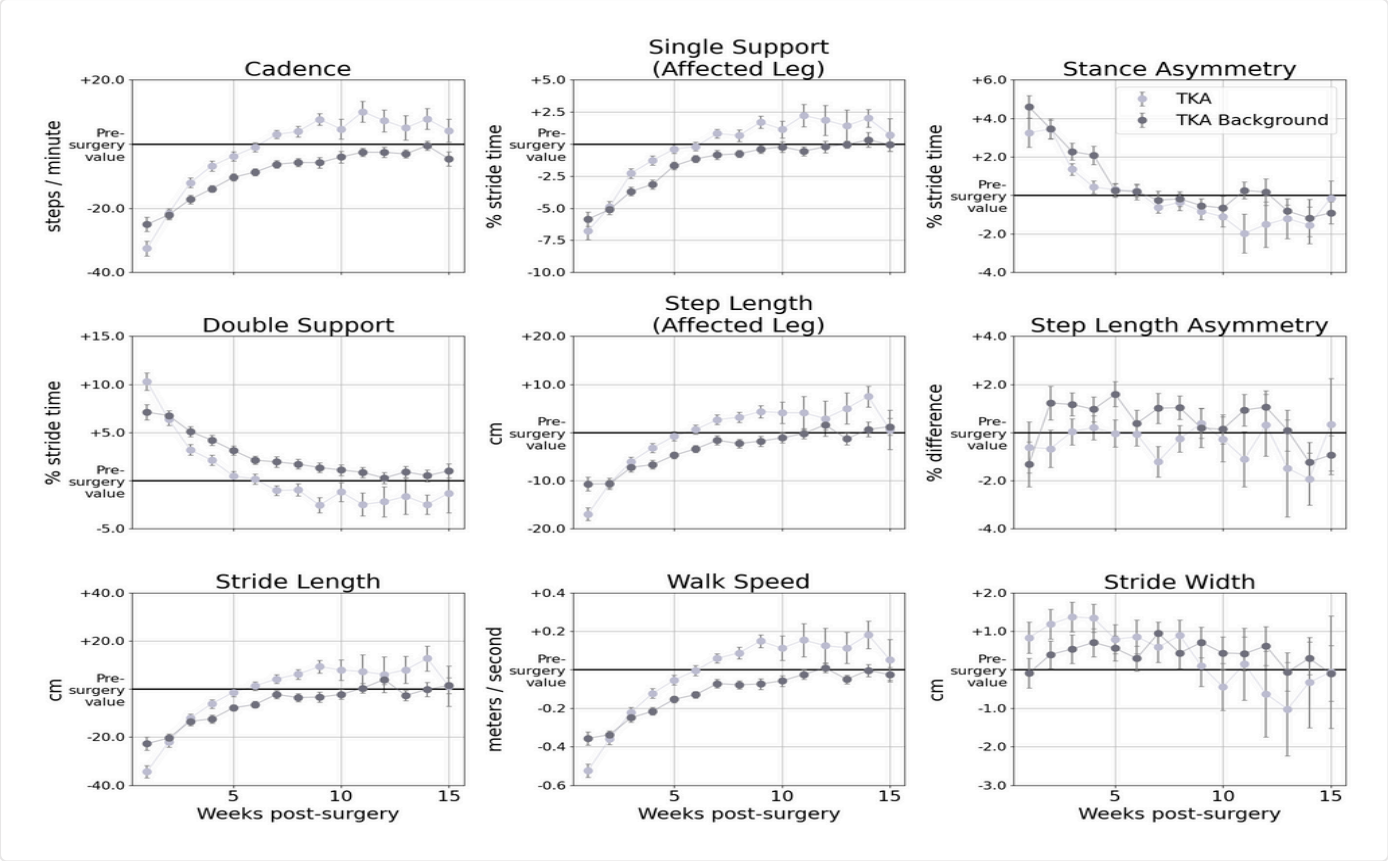


Figure 5. In-app versus background gait trends in TKA. In-app active walks in light grey, background measurements in dark grey.

6 Modelling the recovery curve

In an earlier cohort of 118 patients (75 THA, 43 TKA) followed for 20 weeks, we tested five mathematical models of recovery (linear, quadratic, logarithmic, hyperbolic, exponential) against the nine gait parameters. Two patterns emerged: recovery stabilizes by approximately week 15 for all parameters (many earlier), and there is a stage of very rapid initial recovery in the first few weeks followed by slower recovery. For THA, an exponential asymptotic model fit best by sum of squared residuals (for cadence: linear 339.5, quadratic 104.5, logarithmic 56.6, hyperbolic 29.0, exponential 21.8); for TKA no single model performed best across parameters (Figure 6).

Beyond weekly averages, the distribution of recovery within the cohort was examined over four two-week windows (Figure 7). A patient whose recovery in several parameters falls below the 25th percentile for a given period is a red flag to investigate and adjust the plan of care; a patient who significantly surpasses the typical rate may point to protocols worth studying.

© 2026 OneStep · www.onestep.co

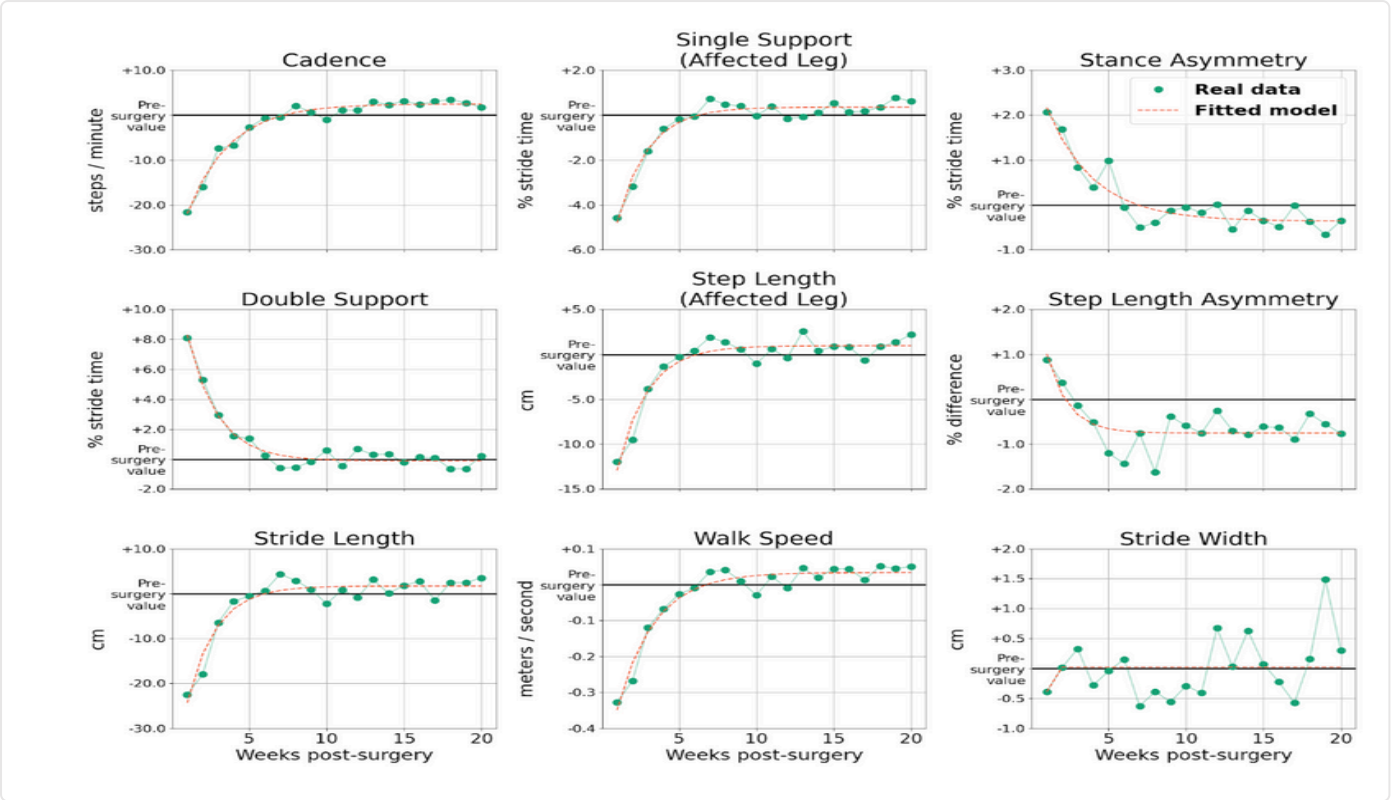


Figure 6. Exponential model of post-THA recovery. Weekly change from pre-surgery value (points) with the fitted exponential model (line) for nine gait parameters, 2023 cohort (n = 75).

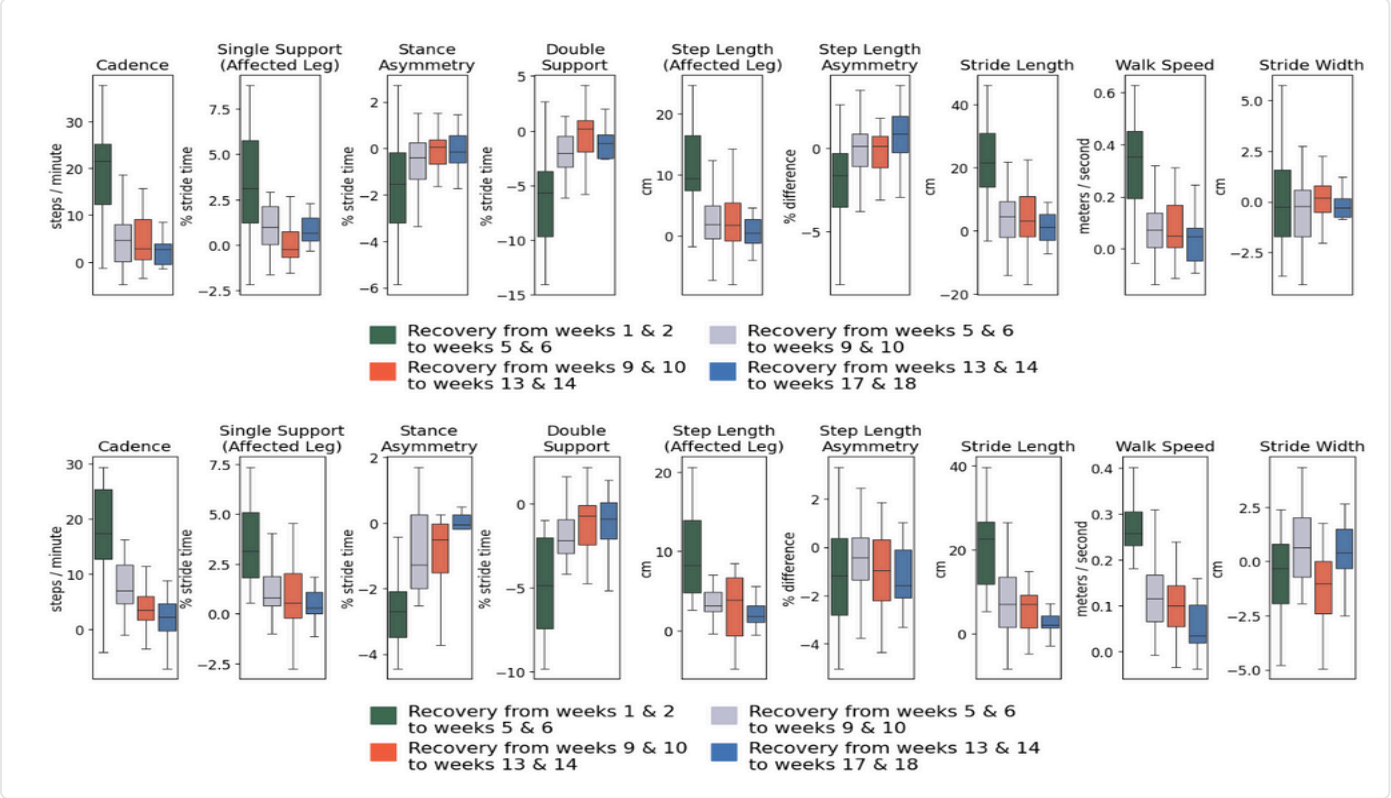


Figure 7. Distribution of recovery within the population. Change in each parameter between consecutive two-week windows (weeks 1–2 to 5–6, 5–6 to 9–10, 9–10 to 13–14, 13–14 to 17–18). Top: THA; bottom: TKA. Boxes span the interquartile range, lines mark the median, whiskers 1.5 × IQR. 2023 cohort.

7 Case studies

7.1 Exceptional recovery after TKA

Patient A, a man in his mid-sixties, recorded walks before TKA and resumed on day 3 post-op. Seven of nine gait parameters reached pre-operative levels by week 6.

© 2026 OneStep · www.onestep.co

Stride length reached its pre-operative level at week 4 and kept improving to week 7, finishing 20 cm longer than before surgery. Double support lagged the normal rate in weeks 1–3 but rebounded to the expected level by week 4. Compared with the population, stride length, step length and walk speed were all above the norm (Figure 8).

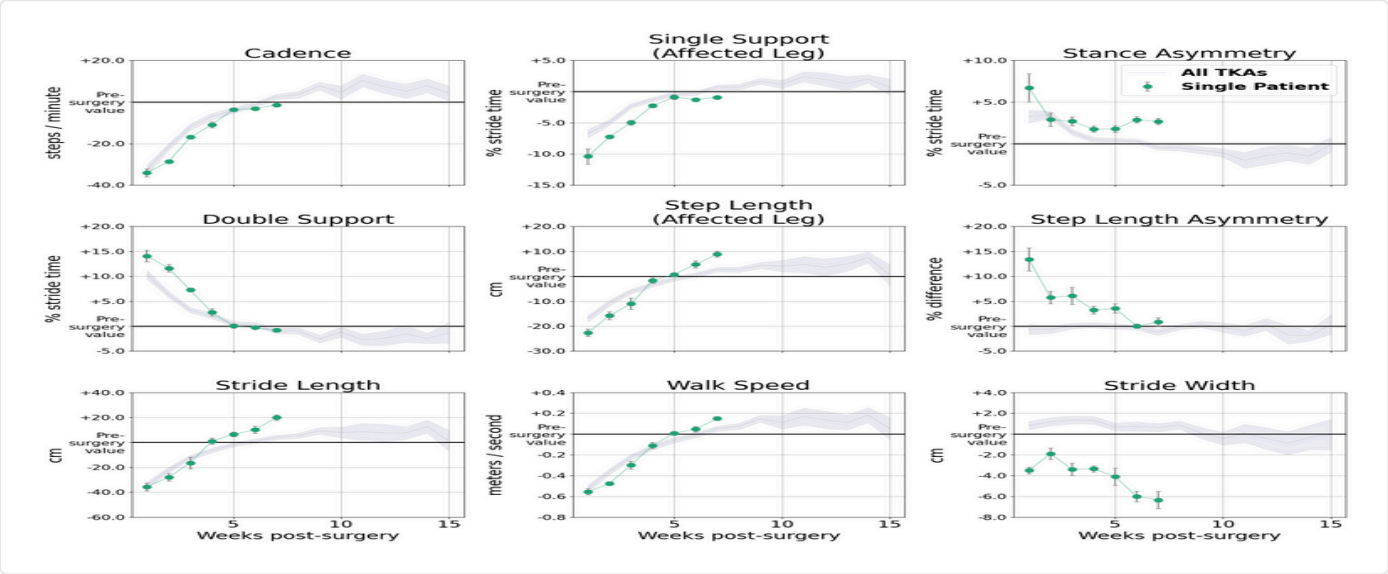


Figure 8. Case study 1. Patient A's recovery (green) against the aggregated post-TKA trajectory (grey).

7.2 Complication after THA

Patient B, a man in his early seventies, underwent a right THA. Post-operatively he experienced emesis and orthostatic hypotension with increased pain during weight-bearing, and was discharged after one night. Persistent severe pain brought him back on post-operative day 3, where X-rays revealed a periprosthetic femur fracture. He underwent open reduction and internal fixation (ORIF) one week after the THA, was placed on partial weight-bearing until week 4 after the second surgery, and recovered steadily thereafter. The gait data (Figure 9) shows the divergence from typical trajectories and the extended recovery that followed the additional surgery.

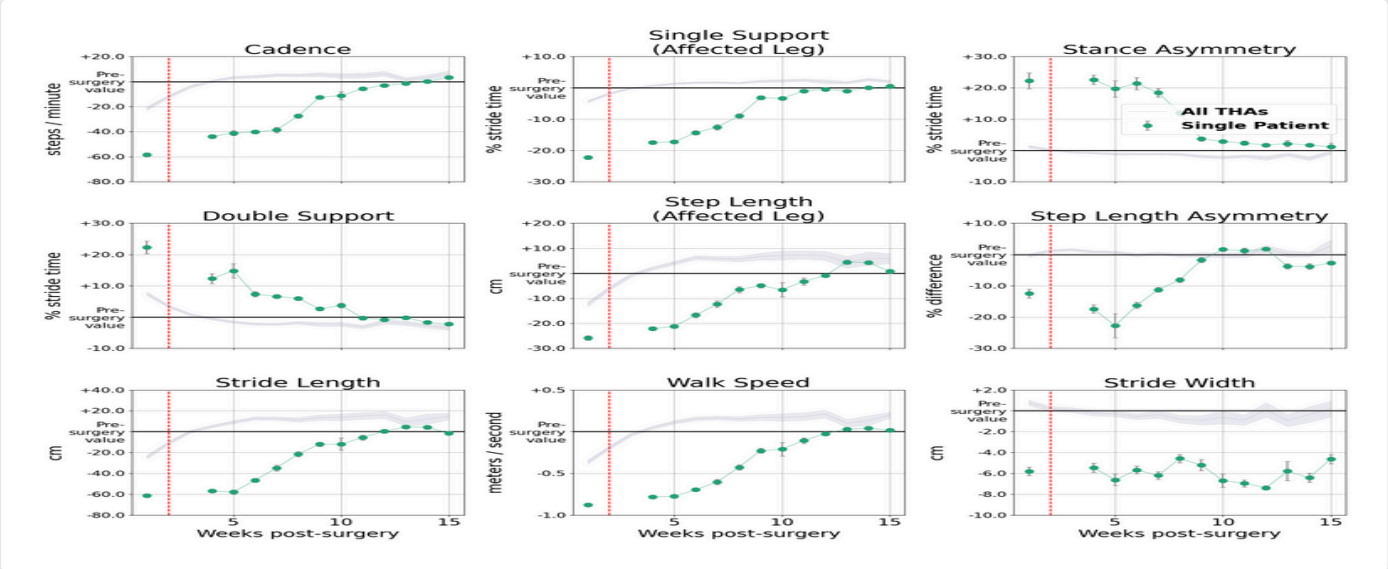


Figure 9. Case study 2. Patient B's recovery (green) against the aggregated post-THA trajectory (grey). The dotted red line marks the date of ORIF.

8 Discussion

A return to pre-operative values for nine gait parameters is faster after THA than after TKA. We also identified variation between surgeons, with one surgeon's patients recovering gait faster than others, a difference that could reflect patient populations, surgical techniques, medications, rehabilitation protocols or a combination. Parameters continued to improve in both groups up to about 10 weeks post-op, at which point patients reached their optimal levels and the trajectory plateaued.

© 2026 OneStep · www.onestep.co

A recent study of global quality of recovery after hip and knee arthroplasty found that individuals who had a TKA showed a larger decrease in global health status post-operatively than the THA group.[3] Our findings reflect a similar pattern. Further analysis is required to correlate gait patterns with global health status; this report did not address confounders such as sex, BMI, comorbidities, medications, psychosocial factors or fitness level.

Walks recorded during in-app sessions demonstrated faster recovery than background walks across all parameters, in both THA and TKA. Possible explanations include the Hawthorne effect (people change their behaviour when they know they are observed); the fact that background walks are collected in varied environments such as outdoors, in a crowded store or while carrying objects; and the incentive to walk faster during a recorded walk because the result is visible immediately. Background data therefore offers a more conservative, real-life picture of recovery.

9 Conclusion

Patients recovering from THA experience faster recovery across gait parameters than TKA patients, with variation influenced by factors such as surgical technique and patient population. Objective benchmarks derived from OneStep's database give surgeons and physical therapists insight into how a patient is recovering relative to the normal trajectory for similar patients, make deviations visible early, and support comparison of protocols and outcomes. Providing patients with objective reference points throughout recovery also supports motivation and adherence.

References

1. Siddiqi A, Levine BR, Springer BD. Highlights of the 2021 American Joint Replacement Registry annual report. *Arthroplast Today*. 2022;13:205–207.
2. Franklin PD, Li W, Ayers DC. The Chitranjan Ranawat Award: functional outcome after total knee replacement varies with patient attributes. *Clin Orthop Relat Res.* 2008;466(11):2597–2604.
3. Perrin T, et al. Early perioperative quality of recovery after hip and knee arthroplasty: a retrospective comparative cohort study. *Int Orthop.* 2023;47(11):2637–2643. doi:10.1007/s00264-023-05903-w

Suggested citation. OneStep Research Team. Tracking gait recovery after total hip and knee arthroplasty. OneStep White Paper; 2026 (consolidated edition of the April 2025 and April 2023 papers). Available at onestep.co/resources.

© 2026 OneStep · www.onestep.co