Differences in Apple Health Mobility Metrics Between Patients Prescribed Early and Delayed Weight-Bearing Protocols

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INTRODUCTION:

- Returning to work is crucial for both patient recovery and livelihood. It is often a primary concern for patients following surgical fixation.
- Non-adherence to weight-bearing protocols can compromise patients' recovery. If patients' smartphones could reliably assess weight-bearing after an injury, there would be numerous benefits to clinical practice
- With 92% of adults in the U.S. using smartphones, Apple iPhones now collect continuous gait data through Apple Health, offering a practical way to monitor patient recovery outside of clinical settings.
- Apple Health mobility metrics are validated against gold-standard gait analysis. Previous research by our group has shown their utility in developing patient-specific recovery curves based on injury and individual characteristics.
- This study aims to further establish the validity of Apple Health mobility data by comparing mobility data between patients following early vs. delayed weightbearing (WB) protocols.

OBJECTIVE:

- This study aims to determine the **sensitivity** of **Apple Health** mobility data in detecting differences in step count between patients assigned to early vs. delayed weightbearing (WB) protocols after fracture surgery.

METHODS:

- **Design**: Retrospective cohort study
- **Setting**: Single academic trauma center
- **Inclusion**: Adults aged 18 and above with lower extremity fractures (pelvic, hip, femoral shaft, distal femur, tibial plateau, pilon, ankle, or hindfoot) treated operatively within 7 days of injury; ownership of an iPhone with Apple Health application for over 1 year.
- **Exclusion**: Patients with bilateral lower extremity injuries, follow-up at another institution, or non-English speakers.
- **Primary Outcome**: Step count, measured by the Apple iPhone Health application.
- **Secondary Outcomes**: Walking speed, step length, walking asymmetry, and double support time.
- **Comparisons**: Between early WB (weight bearing as tolerated within 3 weeks post-fixation) and delayed WB (non-weight bearing or limited weight bearing for 6+ weeks postoperatively) groups.

Figure 1. Daily step count post–injury stratified by weight bearing status.

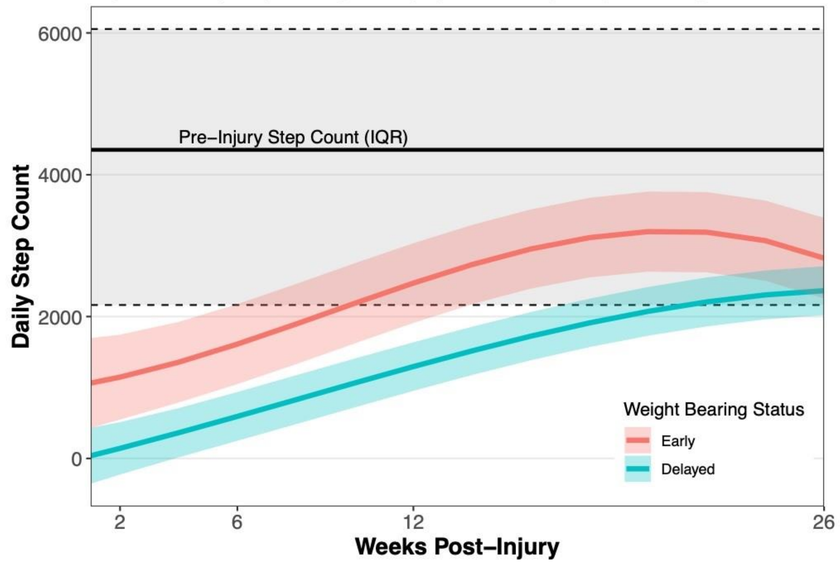


Table 2.1: Adjusted Daily steps

	Weight Bearing (WB)			
	Early WB	Delayed WB	Mean Difference (95% CI)	P
6 Months Pre-Injury, N (CI)	3765 (900 to 6630)	4837 (1807 to 7867)		0.10
Weeks Post-Injury, N (CI)				
2	1146 (548 to 1745)	142 (-227 to 512)	1004 (301 to 1707)	*<0.01
6	1612 (1048 to 2176)	592 (249 to 936)	1020 (359 to 1680)	*<0.01
12	2472 (1910 to 3035)	1295 (953 to 1637)	1177 (519 to 1836)	*<0.01
26	2824 (2256 to 3393)	2365 (2020 to 2710)	459 (-206 to 1124)	0.176

Figure 2. Walking speed post–injury stratified by weight bearing status.

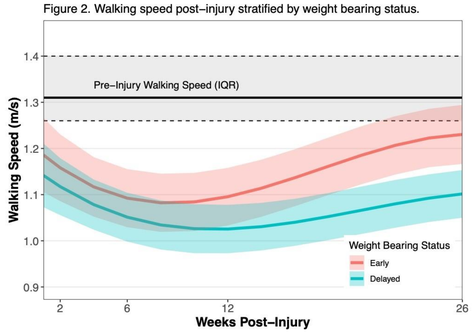


Figure 5. Double support time post–injury stratified by weight bearing status.

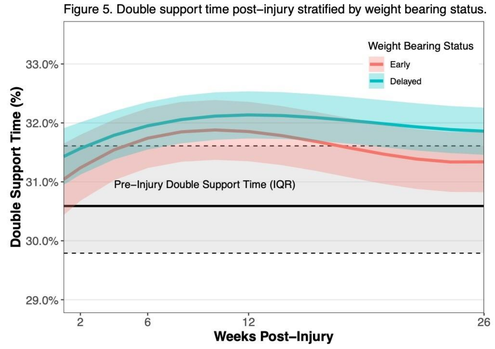


Figure 4. Walking asymmetry post–injury stratified by weight bearing status.

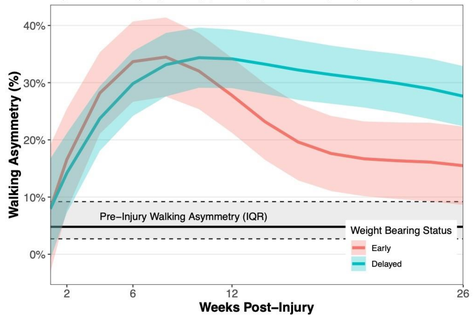
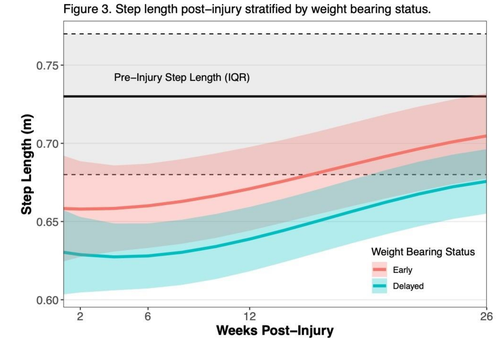


Figure 3. Step length post–injury stratified by weight bearing status.



RESULTS:

- Of the 126 patients enrolled, 33 were excluded due to bilateral injuries and 19 lacked usable Apple Health data, leaving 74 patients (27 early WB, 47 delayed WB).
- The early WB group displayed significantly higher daily step counts than the delayed WB group, with a mean difference of 926 steps (P = 0.007).
- At 2 weeks post-injury, early WB patients averaged 1146 steps per day (95% CI: 548-1745), while delayed WB patients averaged only 142 steps per day (95% CI: -227 to 512).
- By week 26, the early WB group reached 2824 steps per day (95% CI: 2256-3393), compared to 2365 steps (95% CI: 2020-2710) in the delayed WB group.
- Step counts converged by week 26, with the early WB group showing a plateau, while the delayed WB group progressively increased activity.
- These results highlight the importance of early WB protocols in promoting higher mobility early on, with potential implications for recovery timelines and return-to-work planning.

CONCLUSIONS:

- Apple Health mobility data effectively detects differences in step count between early and delayed weightbearing (WB) patients, providing valuable insights for clinicians to assess when patients are ready to return to normal duties.
- Step count showed the most significant differences, with early WB patients achieving higher step counts early on, though both groups converged by 6 months post-injury as delayed WB patients progressively increased activity.
- While the study's use of non-invasive smartphone technology provides continuous, objective data, limitations include the lack of injury-type stratification and exclusion of non-iPhone users.
- These results may suggest the importance of early WB protocols in promoting higher mobility early on, with potential implications for recovery timelines and return-to-work planning.

DISCLOSURES:

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2. Conflicts of interest: Brian Shear, MD owns Apple stock. The remainder of the authors declare no conflicts of interest. The views expressed are those of the authors and do not reflect the official views of the Department of Defense, Uniformed or the US government. Mention of trade names, commercial products, or organizations does not imply endorsement by the US government.