Accuracy in the estimation of self-reported adherence to slim-fit knee brace wear time for young adults at risk of post-traumatic knee osteoarthritis

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Summary

We compared self-reported knee brace wear time with objective measurements using an undisclosed temperature sensor in 10 young adults at risk of post-traumatic osteoarthritis (OA). Overall, we found discrepancies and poor agreement between self-reported and objective measures of knee brace wear time. Future clinical trials should consider objective adherence measures.

Introduction

Slim-fit knee braces have been shown to reduce pain and improve physical function in knee OA [1], but adherence is key to their effectiveness. Self-reported adherence is limited by recall and response bias [2], highlighting the need for objective measurements such as temperature sensors, which are highly accurate at detecting wear time in footwear [3]. We aimed to compare self-reported wear times of a slim-fit knee brace with objective measurements using an undisclosed embedded temperature sensor.

Methods

21 participants were recruited as part of a six-week feasibility study investigating the use of a slim-fit knee brace in young adults at risk of post-traumatic OA. Eligibility criteria included: i) 1-8 years post-anterior cruciate ligament reconstruction (ACLR); ii) age 18-45 years; and iii) ongoing symptoms (mean score <80/100 from four Knee injury and OA Outcome Score subscales ($KOOS_4$)). The 14 participants in the BRACE group were advised to wear the brace for at least one hour per day and during aggravating activities. A temperature sensor (Orthotimer, Balingen, Germany) in the knee brace recorded temperature every 10 minutes. We used a simple wear detection algorithm in Microsoft Excel to identify temperature changes and determine when the brace was donned and doffed [3]. Self-reported wear times were recorded in daily logs. The primary outcomes included i) average daily wear times and total number of days worn and ii) statistical analyses of agreement for daily wear times, total wear time, and 3- and 7-day rolling averages using concordance correlation coefficients (CCC) and 95% limits of agreement (LoA), accounting for repeated measures.

Results and Discussion

Two participants were missing Orthotimer data due to sensor software malfunction, and two participants did not complete their daily logs, leaving 10 participants for analysis (30% male, age 33±6 years, body mass index 27±4 kg/m2, time post-ACLR 4±1 years). Overall, six participants (60%) under-reported the average minutes per day that they wore the brace.

In contrast, nine participants (90%) over-reported the number of days the brace was worn during the intervention period.
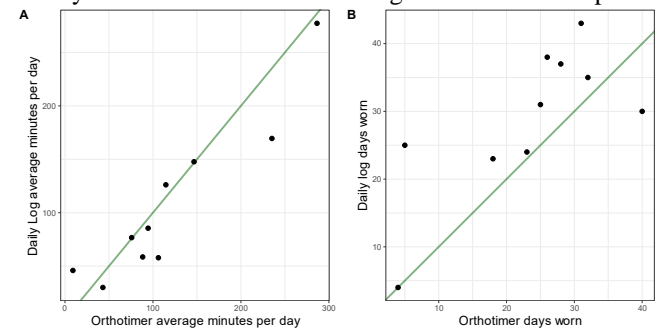
Figure 1: Comparison of self-report (daily log) and Orthotimer data for: a) average minutes per day the knee brace was worn and b) number of days the knee brace was worn over the intervention period

When analysing daily wear times, we observed strong agreement between the Orthotimer and the daily log measurements (CCC = 0.70, 95%CI 0.58 to 0.79). However, 95% LoA were wide (-222.8 to 216.8 minutes), reflecting high variability and poor agreement between the two measures on a daily basis. Agreement improved when evaluating wear time over the total six-week intervention period, with a stronger correlation (CCC = 0.84, 95%CI 0.50 to 0.95) and narrower LoA (daily average wear time -68 to 32 minutes), which could be explained by recall bias being washed out with more aggregated data. Narrower LoA were observed with 3- and 7-day rolling averages (daily average wear time -47 to 36 minutes and -14 to 10 minutes, respectively), suggesting that averaging across days reduces day-to-day fluctuations and improves agreement between the two measures.

Conclusions

Our findings highlight discrepancies between self-reporting and objective measures of knee brace wear. There was a trend towards under-reporting daily minutes of brace wear, but over-reporting the days when participants wore the knee brace. Short-term measures (e.g., daily wear times) showed poor agreement, while longer-term rolling averages improved agreement between the two measures. Future clinical trials should consider objective adherence measures, as these may more accurately reflect intervention usage.

References

[1] Cudejko T et al. (2018). *Arch Phys Med Rehabil,* **99**: 153-163.
[2] Maas JC et al. (2018). Disabil Rehabil. **40**: 398-403.
[3] Menz HB et al. (2020). *Medical Engineering & Physics.* **88**: 19-24.