Submission Summary

Conference Name
International Society of Prosthetics and Orthotics Canada @ RehabWeek

Track Name
Student Poster Competition

Paper ID
26

Paper Title
Accuracy and repeatability of using smartphone-based sensors for orthotic tuning

Abstract
Background: Shank-to-vertical angle (SVA) is a key metric in orthotic tuning for adults and children with pathological gait [Owen (2010) POI]. Goniometry and video recordings are typical tools for measuring SVA. Yet, both often lack accuracy, and videos require extra processing to obtain SVA data. To address these limitations, a smartphone application was developed to evaluate whether the phone's accelerometer can be used to monitor and plot SVA during gait analysis. The purpose of this study was to (1) evaluate the inter- and intra-rater repeatability for measuring SVA with a smartphone, and (2) compare accuracy with traditional motion capture.

Methods: Four clinicians used the smartphone to measure SVA for two unimpaired subjects across two days, one week apart. Each day consisted of three data collection sessions, 40-minutes apart. Each session contained three trials, and five gait cycles were analyzed from each trial. Clinicians were asked to secure the smartphone to the front tibia, a common reference on the leg used to determine SVA. To assess inter- and intra-rater repeatability, SVA throughout gait was compared between clinicians, days, and sessions. Reflective markers placed on the front tibia were tracked with an 8-camera Qualysis system to assess smartphone accuracy.

Results: The average difference between Qualysis and smartphone measures of SVA was 1.20 ± 0.73°, with a maximum error of 6.18°. For repeatability, the average (± 1 SD) differences between clinicians, days, and sessions were 0.96 ± 0.56°, 0.92 ± 0.63°, and 0.67 ± 0.40°, respectively.

Discussion/Conclusion: Mobile sensing can provide an accurate and repeatable method for monitoring SVA using widely-available technology. A smartphone placed on the front tibia showed repeatability and accuracy with average deviations less than 2°. Real-time, smartphone-based sensing of SVA and other gait metrics may improve orthotic tuning and gait training, especially when motion capture is not available.

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