Can we analyse clinical gait using iPhones?: A validation of OpenCap in typically developing children and children with Cerebral Palsy.

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Summary

The purpose of this study was to evaluate the agreement between gait data obtained from marker based (Vicon Nexus) and markerless motion capture systems (OpenCap) in typical and clinical paediatric populations, and to further evaluate if using a common model (OpenSim) improves agreement between systems. Current root mean square error (RMSE) results exceed the Australian clinically acceptable threshold, suggesting that this markerless motion capture method is not yet ready for broad use in the clinical assessment of pathological gait.

Introduction

Markerless motion capture systems are currently gaining popularity in the assessment of human motion due to the low coast, speed, and ease in which data can be collected, processed and provided back to the consumer. Clinically, the application of such systems would greatly improve the accessibility of a medical service (gait analysis) that has been shown to reduce incidences of surgical intervention in clinical populations [1]. One markerless system, Opencap [2], requires only 2 iOS devices for analysis and has been found to estimate mean absolute errors (MAE) of 4.5° for joint angles and 6.2% of body weight for ground reaction forces (GRF) across standardized locomotive tasks in a healthy adult population. There are no current studies in the literature assessing the validity of Opencap for assessment of gait in paediatric populations. The clinically accepted error threshold in Australian clinical guidelines for gait kinematics is 5° [3].

The aims of this study are to assess the validity of using Opencap for assessment of clinical gait in typically developing (TD) and Cerebral Palsy (CP) paediatric cohorts, and to explore differences in kinematic outputs between standard clinical analysis, Opencap outputs, and outputs using a common underlying model in OpenSim.

Methods

TD (n=10) and CP (n=9) participants were invited to attend a single data collection session at the QCMAS. Markers were placed on the skin in accordance with the Plug-in-Gait (PiG) marker set and trials were collected with 12 Vicon Vantage V16 Cameras (marker based data) and 3 iOS devices (markerless data). Static calibration trials were collected for both systems before a minimum of 5 dynamic walking trials towards the iOS devices were collected.

Marker based and markerless data sets were first processed in Vicon Nexus (PiGK) and Opencap (OCk) respectively. Secondary processing for both datasets were performed in OpenSim (OSnx and OCos respectively) using a common model. Statistical analysis included RMSE comparisons and paired t-test statistical parametric mapping (SPM).

Results and Discussion

Statistical comparisons of PiGk and OCk outputs produced RMSE results of 7.65 (TD) and 10.93 (CP), both above the clinical threshold (5°). Most notable differences were seen in pelvis rotation, hip flexion/extension, and hip internal/external rotation for both cohorts (Figure 1).

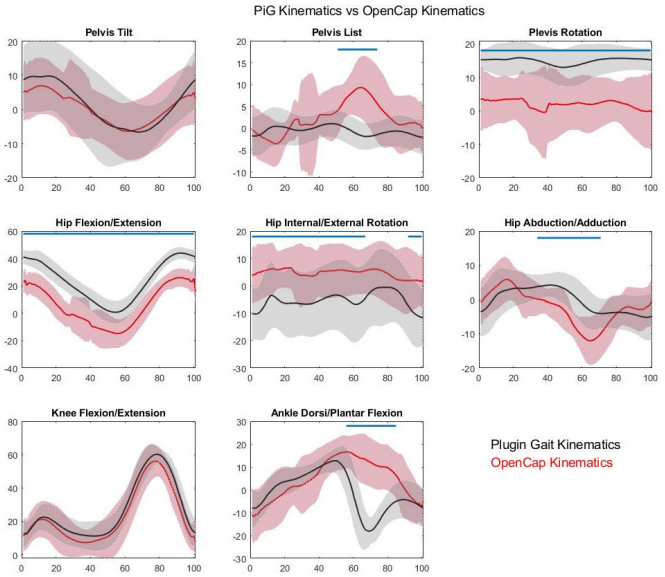

Figure 1: *SPM results for PiGk and OCk comparisons in the CP cohort.*

Following reprocessing of both datasets using a common model, RMSE was reduced to 6.87 (TD) and 7.42 (CP) and reduced magnitudes of error (SD) were seen in SPM results.

Conclusions

Further development and study is required before Opencap can be confidently adopted within a clinical gait service. Whilst results are promising, current outputs do not fall within the clinically acceptable threshold.

Acknowledgments

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References

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