Background

There are currently no standard methods of assessing gait parameters for CAREN treadmill walking. Gait assessment relies on motion capture via body-affixed markers requiring:
1) a trained clinician to appropriately attach the markers to the patient, and
2) a large amount of time to get the patient ready for assessment.

Objective

We propose a simplified motion capture Cluster Marker Set (CMS) that generates sufficiently accurate gait kinematics while allowing fast and easy marker attachment by clinicians accessing the CAREN.

Methods

After attaching two marker sets, a standard Helen-Hayes Marker Set (HMS) and the CMS, each participant walked continuously in the CAREN system for 250 m. Joint kinematic time series were calculated from both marker sets.

Joint kinematics (sagittal) measurements were compared between marker sets and, for the CMS, between different placement of the plates.

Results

Joint kinematics comparisons between HMS and CMS

Joint kinematic measurements calculated using the CMS were found comparable to those obtained from the HMS.

Measurements from the CMS over estimate hip and knee flexion at heel-strike. In addition, hip extension is underestimated at mid-stance when using the CMS.

Although there are differences between joint kinematic estimates from the HMS and the CMS, differences were found to be small and contained within normal gait variation limits (±5º).

Effect of plates placement on joint kinematic measurements

Knee joint kinematics were calculated using two different sets of CMS markers on the thigh (Thigh1 and Thigh2) and shank (Shank1 and Shank2) segments.

Differences in knee joint kinematics estimates related to the placement of the CMS plates were found to be small (±2.5º).

Although the CMS might not be as accurate to estimate joint movement as the HMS, the CMS is highly stable and does not rely on plates placement to produce repeatable estimates.

CMS dynamic calibration algorithm

1) Plates are placed on the participant with no specific orientation.
2) Data is collected while the patient performs a calibration task (i.e., 3 repetitions of sit to stand
3) Plates are re-orientated based on the dynamic calibration!

Triads defined for each segment with the calibrated CMS are oriented similar to the triads created using the HMS.

Conclusion

The results from this study suggest a novel, clinically usable simplified marker set and gait analysis protocol for the CAREN system.

It does not require specialized expertise in anatomical marker placement and yet provides reliable kinematics data to be used during assessment and rehabilitation sessions on the CAREN.

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DEVELOPMENT OF A SIMPLIFIED MOTION CAPTURE MARKER SET TO ENHANCE REHABILITATION IN THE CAREN SYSTEM

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