

Upper Extremity and Trunk Movement During Normal Gait

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Introduction

Motion studies on normal gait mainly focus on the lower extremity. While there have been models developed to look at specific movements of the upper body such as throwing and other activities, these models vary widely in marker placement, joint center calculation, and rotation sequence. Recently, an upper extremity model was developed by Rab, et al. (2002) to look at upper extremity and trunk movement. This model minimizes the number of markers applied to the subject, eliminates the need for static measurements on the subject prior to data collection, and uses a rotation sequence that yields clinically relevant information. Currently, it is being used to look at upper body motion during activities of daily living such as hand to head, waving, and receiving change. A pilot study was undertaken to apply the Rab model to gait and to begin developing a normal database of upper extremity and trunk movement during gait.

Statement of Clinical Significance

Full body assessment will yield a better understanding of the contribution of the trunk and arms to normal gait. In addition, this will provide a clearer picture of patients that use extreme trunk and arm motion during gait.

Methods

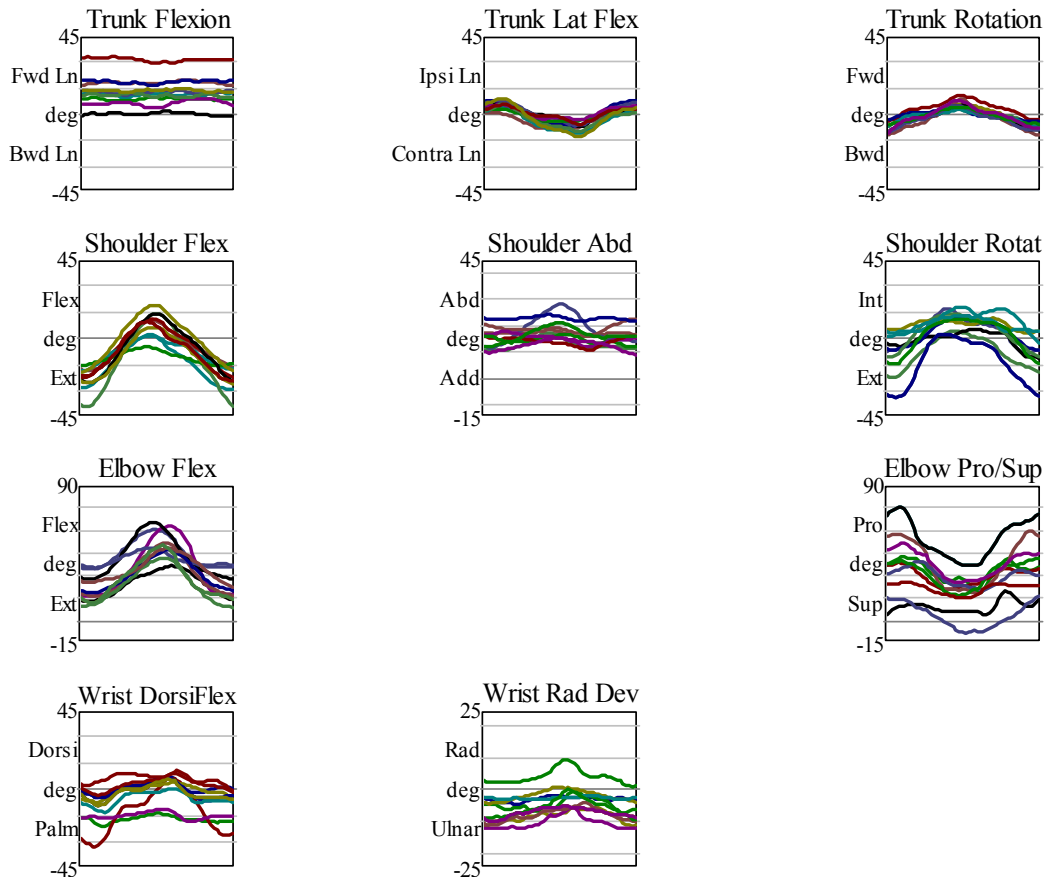
A collaborative effort was undertaken to translate the Rab model that was written for ExpertVision (Motion Analysis Corporation) to a Bodybuilder (Oxford Metrics) model. Once the translation was completed, the models were analyzed for identical outputs (Rab, et al 2003).

Two clinicians performed computerized gait analysis on 10 normal adults (8 Females and 2 Males, mean age 31.4 ± 6.4) using an 8-camera VICON 612 system (Oxford Metrics) with two AMTI force plates. Thirteen reflective markers were placed on the lower extremities in accordance with the model described by Vicon Clinical Manager (VCM). Eighteen markers were placed on the upper extremity in accordance with the Rab model. For each subject, a static trial was collected before the dynamic trials. A minimum of ten dynamic trials was collected with the subjects walking at their self-selected speed. For data analysis purposes, one side was randomly chosen and five representative trials for each subject was selected for processing. The five dynamic trials were processed with the Rab model. No filters were applied. The Plug-in Gait (PIG) lower body model was run on all of the trials using a "VCM like" spline filter.

The five trials for each subject were averaged using Polygon (Oxford Metrics) and the mean kinematic variables for head, trunk, pelvis, shoulder, elbow, and wrist were output.

Results

Graph 1 shows the mean for all ten subjects for only the trunk, shoulder, elbow, and wrist. The mean velocity for each subject varied from 1.14 to 1.85 m/s (mean 1.40 m/s \pm 0.19).



Graph 1. Trunk, Shoulder, Elbow, and Wrist mean kinematics for all 10 subjects.

Discussion

The kinematics shows some areas of variability most notably in shoulder rotation, forearm pronation, and at the wrist. This may be due to marker placement or individual variability. In addition, there may be some variability due to differences in walking velocity. For example, the subject with the highest velocity (1.85 m/s) demonstrated shoulder extension near 45°. There were also differences seen with the two male subjects. Their shoulder and elbow flexion range was lower than the female subjects and they demonstrated more elbow flexion. This model patterned upper extremity motion during gait well, but variability was seen likely due to marker placement, subject, and velocity.

References

Rab, G, et al. *Gait & Posture*, 15(2): 113-119, 2002.
Rab, G, et al, Submitted to 2003 GCMAS Annual Meeting

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