TEST-RETEST RELIABILITY OF A VIDEO-BASED GAIT ANALYSIS SYSTEM

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INTRODUCTION

Biomechanical gait analysis is used widely as an objective tool to evaluate the walking capability of patients before and after various sorts of treatment e.g. surgery or rehabilitation. It is therefore important to know the test-retest reliability of each gait analysis system from day to day experiments. The present study evaluated the Ariel Performance Analysis System (APAS) (Ariel Dynamics Inc. CA USA), which is a low cost video-based system opposed to e.g. the more expensive VICON system, which has been evaluated during walking by Kabada et al. [1]. The APAS system has previously been evaluated for accuracy [2], but the reliability from day to day has never been tested in relation to kinematics and kinetics during walking.

METHODS

Nine healthy subjects (aged 25-46 years) were analyzed at the same walking speed (4.5 km/h) on two different days separated by four weeks. Reflective markers were placed on anatomical landmarks according to the marker setup described by Vaughan et al. [3] The markers were positioned by the same person on both days. The subjects walked across two force platforms (AMTI OR6-5-1) while the movements were recorded by five video cameras (Panasonic WV-GL350) operating at 50 frames per second. Three-dimensional coordinates of the markers were calculated by direct linear transformation, coordinates of joint centres were calculated according to Vaughan et al. [3] and all coordinates were low-pass filtered at 6 Hz. All kinematic and kinetic calculations were performed in Matlab by custom-made programs. Net joint moments in the lower extremities were computed by combining the movement data and the force plate data. The moments were calculated about anatomical axes corresponding to flexion/extension, abduction/adduction and internal/external rotation. Joint moments were normalized to body mass. Six trials were collected for each subject and averaged for each day.
Bland-Altman tests [4] were used to test reliability between days and Spearman's rank-correlation was used to evaluate the similarity between curve-patterns of the calculated parameters.

RESULTS AND DISCUSSION

The Bland-Altman test showed that both joint moments and joint angles were highly reproducible from day to day. Figure 1 shows the net joint moments for flexion/extension (stance phase) about the ankle, knee and hip joint averaged for all subjects and for two days. It is seen that the curves appear highly identical on both days and the Spearman r-values were above 0.94. In general, the parameters calculated in the frontal plane showed more variability and somewhat lower r-values. It is suggested that this was caused by a lower signal to noise

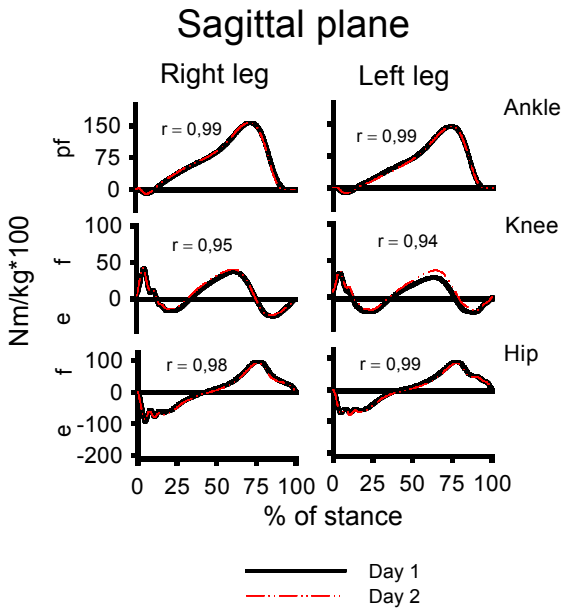

Figure 1: Stance phase joint moments in the sagittal plane normalized to body weight. r = Spearman's coefficient.

ratio than in the sagittal plane in which the more significant movements take place during walking. Likewise, internal/external rotations showed higher variability than the sagittal parameters. In general, the day to day variability is likely to originate from small variations in the placement of markers and/or actual differences in the walking pattern of the subjects from day to day. The latter was partly controlled for by forcing the subjects to walk at the same speed on both days, which is considered an important prerequisite conducting a test-retest study.

CONCLUSIONS

A low-cost video-based analysis system proved to be reliable in reproducing gait parameters on two different occasions. Both the kinematic as well as the more complex kinetic parameters were highly reproducible from day to day.

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