

CONSTRUCT VALIDITY OF MARKERLESS 3D GAIT KINEMATICS IN HEALTHY OLDER ADULTS

*Andreia Carvalho^{1,2}, Jos Vanrenterghem², Ana Assunção¹, Sílvia Cabral¹,
António Prieto-Veloso¹ e Vera Moniz-Pereira¹*

¹ LBMF, CIPER, Fac. de Motricidade Humana, Universidade Lisboa, Portugal

² Musculoskeletal Rehabilitation Research Group, Fac. of Movement and Rehab. Sciences, Leuven KU, Belgium

andreiaffcarvalho@gmail.com; jos.vanrenterghem@kuleuven.be; aassuncao@edu.ulisboa.pt;
scabral@fmh.ulisboa.pt; apveloso@fmh.ulisboa.pt; veramps@fmh.ulisboa.pt

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1 INTRODUCTION

In older adults, illnesses often alter walking patterns, making gait analysis crucial for diagnosis [1]. However, accurate 3D gait analysis is challenging. This study evaluates the construct validity of a novel markerless motion capture system for measuring walking kinematics in healthy older adults, compared to a markerbased method.

2 METHODS

Thirty community-dwelling healthy older adults (75±8 years) were recruited. Gait analysis was conducted using a markerbased and a markerless system (both 85Hz) separately, in a single laboratory session, through 9 infrared cameras (Oqus, Qualisys, SE), and 8 video cameras (Miquis, Qualisys, SE), respectively. Participants wore tight fitting clothes allowing the attachment of 46 reflexive markers on the skin/shoes (based on CAST) for markerbased, and wore their usual clothes and sports shoes, for markerless data collection. Markerless video data were processed with Theia3D (Markerless Inc, CA, v2023.1.0.310,), using an IK 3D pose estimation (8Hz filter). For the markerbased data, an 8-segment model (thorax, pelvis, thighs, shanks, and feet) was built according to Robertson et al. [2]. The same IK approach used from Theia3D was followed. Markerbased modeling and lower limb joint angle computations (XYZ Cardan sequence) were executed in Visual3D (Has-Motion, Inc, CA). Cross-correlation coefficient (Rxy) was calculated to measure the similarity between markerless and markerbased joint angles curves, for each participant and averaged, as well as the mean difference between the two methods. An Rxy above 0.70 was considered a strong correlation and mean differences below 5° an acceptable agreement.

3 RESULTS

Gait lower limb kinematics showed a very strong correlation (≥ 0.9) between markerbased and markerless methods in the sagittal plane, except for the pelvis, which showed a weak correlation. The hip flexion/extension and anterior/posterior pelvic tilt revealed mean differences between methods mostly higher than 5° across the gait cycle. Overall, in the other two movement planes, the correlation ranged from weak to moderate (0.17-0.49), except for pelvis frontal plane (negligible correlation), pelvis transverse plane motion, and ankle frontal plane motion (strong correlation). The results are shown in Figure 1.

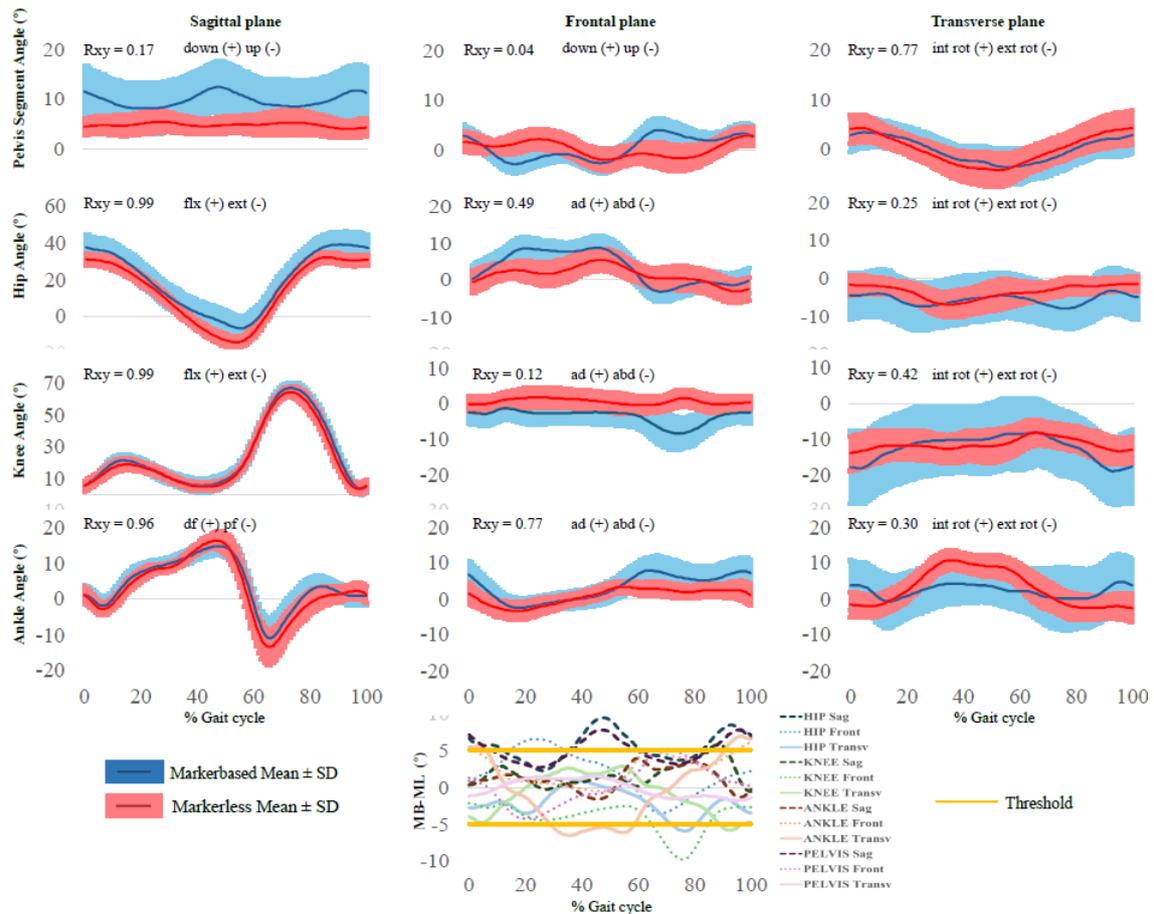


Figure 1 – Gait cycle waveforms and between systems time-continuous mean differences.

4 DISCUSSION AND CONCLUSION

Overall, the results demonstrated that sagittal plane gait kinematics obtained from the markerless system is strongly correlated with those acquired with the markerbased system, with larger mean differences in the hip and pelvis angles, and knee frontal and ankle transverse kinematics (along with weaker correlations). In the remaining parameters, the agreement can be considered acceptable. The strong correlation for sagittal plane motion and weaker correlation for other movement planes, along with globally acceptable differences between the markerbased and markerless kinematics, are in line with previous studies [3], [4]. These results show that markerless systems like Theia3D are promising tools for gait analysis in healthy older adults.

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