THE INFLUENCE OF DIFFERENT METHODS AND EXAMINERS ON GAIT KINEMATIC DATA: A PRELIMINARY STUDY

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INTRODUCTION

Motion capture using a video-based optoelectronic stereophotogrammetric system (OSS) allows the assessment of the instantaneous positions of markers located on the surface of the skin and, thus, a kinematics analysis of movement. An OSS is worth nothing if the physical markers are not rigidly associated with the bones and, even in static conditions, reconstructed marker positions are not stationary, due to errors intrinsic to the measuring system [2]. In a non-invasive technique there are 3 sources of error affecting in vivo estimation of the pose of a skeletal bone: instrumental errors, soft tissue artifacts (STA) and anatomical landmark (AL) misplacement [1]. In order to obtain accurate data for movement analysis, one should assess and try to compensate the errors generated during the motion capture.

The purpose of this preliminay study was to verify the influence of the method and the examiner on the gait kinematic data collected with the OSS of our laboratory. This was done by: comparing two AL placement protocols (real AL, fixed on the skin (RAL), vs vitual AL, created with a pointer (VAL)), assessing inter-examiner precision and doing a residual analysis of the lower limb segment lengths.

METHODS

Six sports sciences students of the University (age: 20.12±0.78), without any gait pathology, participated in the study. The later procedures were followed: (1) anthropometric data assessment, (2) palpation and fixation of the real ALs, (3) data collection I - static and dynamic (gait) trial. A 10 camera (Oqus 300) OSS, from Qualisys Motion Capture System at a sample frequency of 200Hz was used, (4) palpation and creation of the virtual ALs using Visual 3D from C-motion inc, (5) data collection II - static and dynamic (gait) trial (6) Repetition of steps 1 to 5 for the two examiners. In Visual 3D right lower limb lengths, segment lengths residuals and angular displacement in the sagital plan was collected. Statistical analysis was done with with SPSS 16.0 and included: a) a Kolmogorov-Smirnov test of normality, b) descriptive statistics to determine central tendency and standard deviation and c) analysis of variance with repeated measures to see the influence of the method and the examiner on the kinematic data, d) a correlation analysis to measure the correlation between methods and examiners, e) effect size analysis.

RESULTS AND DISCUSSION

Neither the method nor the examiner seemed to have influence in the tested gait kinematic variables. The only significant result was obtained for the interaction between the method and the examiner in maximal Knee ROM. There was a high value for the correlation coefficient between methods and examiners (all ≥0.9) for the tested variables. Effect size analysis showed, for some variables, that both the examiner and method can be responsible for ~40% of the results variability. In order to increase the meaning of our data and results a larger sample of subjects should be tested by a larger number of examiners.

The value of the error estimated through the segments residuals for both methods is superior for the foot (~4%) and does not reach 1% for the shank and the thigh (table 1). This was probably due to the camera set up, since none of the cameras was at foot level.

CONCLUSIONS

With this preliminary study neither the method nor the examiner seemed to have influence in the kinematic data. However, effect size analysis suggest that, in order to be able to compare data collected with different examiners or methods, one should first assess the influence of both in the data of a specific task.

Besides that, each laboratory should also perform studies about the best data collection procedures for a specific task. Even with the best possible conditions achieved, error assessment and compensation should be performed for each evaluated task.

REFERENCES

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Table 1: Residuals of segment lengths and error estimation

	Length (m)		Length Residuals (m)						Estimated Error (%)					
	Total Average		Average		Max		Min		Average		Max		Min	
	RAL	VAL	RAL	VAL	RAL	VAL	RAL	VAL	RAL	VAL	RAL	VAL	RAL	VAL
Foot	0.124	0.125	0.005	0.005	0.008	0.008	0.003	0.003	4.35	4.30	6.64	6.74	2.74	2.71
Shank	0.389	0.391	0.002	0.002	0.004	0.004	0.001	0.001	0.58	0.59	1.01	1.07	0.27	0.26
Thigh	0.409	0.402	0.003	0.003	0.006	0.005	0.001	0.001	0.74	0.71	1.48	1.15	0.35	0.33