RELIABILITY OF JOINT KINEMATICS IN GAIT OF HEMIPLEGIC AND HEMIPARETIC PATIENTS

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Introduction

In gait analysis the operator often needs to select one of the acquired trials as a reference for the analysis of the case. Which trial should be selected? The reliability of normal gait is described in literature [1], [2], whereas no data about the reliability of pathological gait are available. Aim of this study is to verify the intra-session reliability of kinematics data in gait of hemiplegic and hemiparetic patients. We introduce an indicator of reliability and investigate its dependence, if any, on the examined angle, the pathology and the affected side. The clinical outcome of this study is to provide a support to the clinician, while selecting the trial for the report.

Patients, materials and methods

Seventy-five patients were included in this study: 23 right hemiparetic, 24 left hemiparetic, 9 right hemiplegic and 19 left hemiplegic. Data were acquired into the gait laboratory of the Sol et Salus private hospital in Torre Pedrera, Rimini, Italy, using an Elite system (BTS, Italy) with six cameras at 50 Hz and two dynamometric force plates (Kistler, Switzerland). Markers were positioned using the anatomical Davis protocol. At least three trial for each limb were acquired. Gait velocity, normalized to patient's height, was used as clinical indicator of the residual motor ability: velocity distribution allows to describe the sample in terms of the disease level. Angles typically used for patient's evaluation were included in the study: inclination, tilt and rotation of the pelvis, abduction-adduction, flex-extension and rotation of the hip, knee flex-extension, ankle dorsi-plantaflexion and foot progression. For each patient, joint kinematics data relative to all strides along the entire walkway, for all consecutive trials were grouped. Stride with missing data, due to a missed recognition of markers, were discarded, thus obtaining 6-8 stride for each patient. Data were resampled on the gait cycle, paying attention to avoid the shape artefacts that the resampling process could introduce into curves' morphology. For each angle the mean waveform during the cycle and its standard deviation were computed. The maximum value of the standard deviation during the cycle was selected as indicator of reliability: the variability during the cycle is always lower or equal than this value. This indicator, measured in degrees, is not influenced by either the range or the mean value of the curve, and allows to compare the reliability of different joint angles. The influence on the maximum standard deviation of the side (right vs. left), of the pathology (hemiplegia vs. hemiparesis) and of the affected side (affected vs. unaffected) was investigated by means of a Wicolxon test and ANOVA respectively, with $\alpha = 0,05$.

Results

Gait velocity distribution is almost uniform in the sample and ranges from values lower than 0,2 (m/s)/m, typical of very compromised patients, to values greater than 0,9 (m/s)/s, typical of healthy subjects. The sample includes all levels of residual motor ability. Intra-session kinematics data are reliable for each patient: the maximum standard deviation, that is the worst value during the cycle, is lower than 3 degrees for angles that describe pelvic obliquity, pelvic tilt and hip ab-adduction, lower than 6 degrees for pelvic rotation, hip flex-extension, hip rotation, ankle flex-extension and foot progression, whereas it reaches 9 degrees for knee flex-extension. Reported values relate to the 75 percentile. No statistically significant differences in the reliability were found between sides and pathologies.

Conclusions

Kinematics data of hemiplegic and hemiparetic patients are reliable within session for both slightly and very compromised patients. No differences can be found, in reliability, between neither pathological and healthy side nor hemiplegic and hemiparetic patients. The high reliability of kinematics data at the pelvis could be related to the increased rigidity of pelvis and trunk and to fixed patterns of compensatory mechanisms. The variability in knee flex-extension is mostly due to the misalignment of the flexion peak in different curves, that alters the ensemble averaging. Data analysis indicates that trials are equivalent for report creation.

References

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2. Chan Wai Hon Me Me D. et al. *Vicon Reliability*, from www.univie.ac.at/cga/faq/reliability