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Title
Reference Values for Gait using Outcomes of the Gait Analysis System RehaWatch

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Summary
The knowledge of reference values is useful for the interpretation of gait analysis results. We present a method to receive reference values from measurements with healthy subjects. These standard values are determined depending on age, body height and gait velocity, based on a linear model.

Introduction
Gait analysis plays an important role in the neurological or orthopedic rehabilitation process for the assessment of the rehabilitation progress. The gait analysis system RehaWatch is denoted as a portable and easy to use gait analysis device. The basic principle is the usage of motion sensors fastened near the left and the right malleolus by special brackets. The related RehaWatch PC software computes from the measured acceleration and rate of turn values a set of time and space related variables, parameters and symmetry indexes, e. g. double step time, cadence, stance time, swing time, velocity, step length, sagittal foot angle. An important prerequisite for the evaluation of gait analysis results is the existence of reference values gained on the investigation of healthy subjects. These subjects should represent a profile of the adult population. The usability of such reference values increases by including biometric values such as gender, body height and age.

Methods
119 subjects took part on the measurements for the gain of reference values. The absence of former or actual diseases was excluded by an interview with standardized questions. The 119 subjects consist of 58 women from 20 to 74 years of age and 61 men from 19 to 73 years of age.

Each subject passed 3 measurements on an even course of 20 meters. This procedure took roughly 10 minutes per subject. All measurements were analyzed by the RehaWatch software, this means, the gait parameters were calculated. All results were exported to EXCEL and SPSS and given to statistical estimation.

Results

We performed correlation analyses to decide on independent variables. In the results of this examination we found age, body height and gait velocity. Then we used these variables for linear regression analyses and found significant relations for the prediction of stride time, stride time variability, stance duration, stride length and sagittal foot angle. Using linear regression analysis is based on the simplifying assumption, that we have linear relationships between these and other gait variables.

By means of the estimated regression parameters, we calculated auxiliary quantities by appointing a comparative person that is 50 years old, 170 centimetres high and has gait celerity of 1,4 meter per second. Although all of the calculations and the final percentiles are gender-specific, we don’t have to take sex into account here. The comparative person’s characteristics are arbitrarily chosen and just figure in the mathematical background.

Having these auxiliary quantities, we ensured that they were approximately normally distributed and transformed them into standardised normally distributed values by subtracting the mean and dividing by the standard deviation. Then it was possible to calculate percentiles of the derived standardised normally distributed variables.

In order to compare a new patient’s gait analysis outcome the user has to input age and height. The resulting quantile is given automatically and can then be compared with the pre-specified percentiles.

Conclusion

The presented method allows the evaluation of gait parameters whether they are to low, to high or in the same range like the reference values taking into account biometric values like body height, gender and age. As a further step this method should be transferred from a particular excel sheet to an integral part the program code of the RehaWatch software. This would be an easement in the process of gait results interpretation.

References

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