

THE STUDY AND APPLICATION OF THE INERTIA GAIT

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INTRODUCTION: The aim is to develop a system of measurement suitable for both experimental (during sports) and clinical use which could be operated simply and with minimal disturbance of gait in situations outside the biomechanics laboratory. The use of accelerometers for the measurement of human gait parameters has not been widely accepted in biomechanics. However, several bioengineers and biomechanics in sports are interested in this field. Such readily obtainable information provides an index by which patient progress along the continuum of functional impairment may be monitored. The measurement of acceleration with subsequent integration can estimate velocity and position with reduced noise as Ladin et al., 1989).

METHODS: The gait analysis system consists of inertia accelerometer, electro-goniometer, amplifier-power supply interface, computer system and walkway, the laboratory walkway used for gait analysis. The subject wore the measurement shoe and attached goniometers. The initial output of each accelerometer was calibrated. In this subjects, there were 51 men (average age 29 year, mean weight 64 kg) and 42 women (average age 25.5 year, mean weight 54 kg). The five patients were male (average age 33.5 year, mean weight 65 kg).

RESULTS: The peak accelerations in each direction are presented in terms of the acceleration unit $g=9.81m/s$ and the timing of these peak accelerations are presented as a percentage of the gait cycle, we can show it in table 1. The mean cycle time 1.39 s for normal subjects and 1.87 s for the patients. Compared to normal subjects, the five patients with incomplete paraplegia showed that the peak acceleration in the fore-aft direction was lowered ($< 0.5 g$).

Table 1 Peak acceleration and corresponding time for one location

	Peak acceleration (g)	Timing (o/o cycle)
Fore-aft direction	-2.0900 ± 0.580	68.79 ± 2.90
	$+1.8900 \pm 0.580$	99.00 ± 1.39
Up-down direction	$+1.0020 \pm 0.290$	68.50 ± 4.09
	-2.0010 ± 0.890	97.80 ± 2.25
Right-left direction	$+0.7700 \pm 0.210$	64.70 ± 4.89
	-1.0003 ± 0.303	94.40 ± 1.69

DISCUSSION: The results show that the acceleration of the lower leg during walking on level ground in 93 normal subjects varied with different phase, different direction and each measurement point. In the fore-aft direction, a negative peak acceleration appeared at toe-off and acceleration phase (65-70 %). In the vertical direction a positive peak acceleration appeared at early swing phase and a negative peak at the end of swing phase, at same time, there were two negative peaks and two positive peaks, for three different positions.

CONCLUSION: In this article, although this work does not attempt to analyse fully the parameters of gait. The inertial gait analysis apparatus provided an objective measure of acceleration of the lower leg and it is hoped to use the technique more extensively in clinical work and developed the method for use in the study of the sports movement.

REFERENCES: Ladin, Z., Flowers, W. C. and Messner, W., (1989). A quantitative comparison of a position measurement system and accelerometry. J. Biomechanics, vol. 22:295-308.