GAIT ANALYSIS BY MEANS OF ACCELEROMETRY IN PATIENTS WITH HAEMOPHILIC ARTHROPATHY

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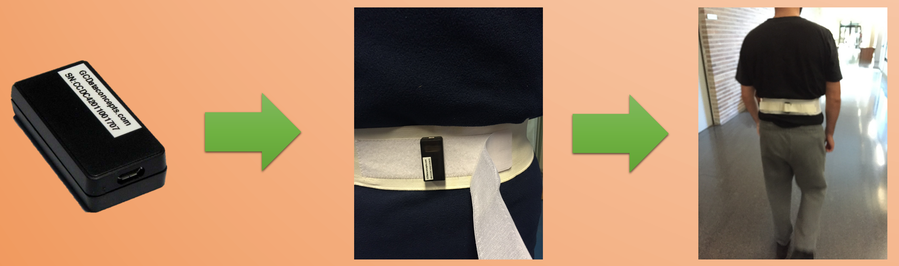
1. Introduction and Objectives:

The Harmonic Ratio (HR) is a measure, derived from the analysis of gait accelerometry, used to quantify walking smoothness. This tool can help to evaluate the altered gait characteristics in haemophilic patients. Hence, the **objective of this study** is to determine the utility of the HR tool in the quantification of arthropathy.

2. Materials and Methods:

- A total of 23 severe A haemophilic patients participated in the study [Age: 35.39 (9.40) years old; IMC: 24.83 (3.74) Kg/m^2; HJHS score in knees: 2.67 (3.92) and gait: 2.48 (1.59); Pettersson radiological score in knees: 2.50 (4.46)].
- The device used to acquire the signals was the X16-mini accelerometer (Gulf Coast Data Concepts, LLC).
- Patients walked 30 m along a straight line at preferred speed with the accelerometer placed (using a belt) at L3/L4 vertebrae. Then, the HR of Vertical (V), Anterior Posterior (AP) and Medial Lateral (ML) signals as well as the velocity of the gait was obtained.
- The statistical analysis includes the correlation among HRs parameters with HJHS, gait and Petterson scores in knees. In addition, analysis of variance of the HRs measures grouping with the HJHS gait score (0, 1, 2, 3, 4) was made.



3. Results:

The analysis shows (Table 1) moderate correlation among the HR_AP ratio and speed with the HJHS, gait and Petterson. Lower HR ratios and speed indicate greater arthropathy. ANOVA shows (Table 2) significant differences in the HRs between the distinct gait score groups for HR_V, HR_AP and speed.

4. Conclusions:

Results obtained suggest that HR can be a promising tool for the detection of knee arthropathy and gait alterations in patients with haemophilia. Therefore, a larger sample size is needed to improve the analysis.

Table 1. Results obtained with the Pearson correlations.

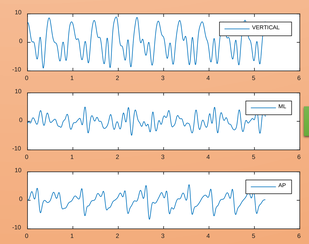
Pearson	HJHS		Gait HJHS		Pettersson	
	r	p	r	p	r	p
HR_V	-0.27	0.22	**-0.45**	**0.03***	-0.23	0.28
HR_AP	**-0.54**	**0.01***	**-0.50**	**0.02***	**-0.42**	**0.05***
HR_ML	-0.11	0.61	-0.23	0.28	-0.20	0.37
Speed (m/sec)	**-0.49**	**0.02***	**-0.62**	**0.00***	**-0.50**	**0.01***

Table 2. Results obtained with the ANOVA analysis.

ANOVA (gait score)	0		1		2		3		4		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p
HR_V	2.83	0.16	2.72	0.34	3.09	0.59	3.17	1.26	2.04	0.68	**0.04***
HR_AP	3.25	0.33	2.93	0.55	2.48	0.73	3.75	1.03	2.09	0.64	**0.01***
HR_ML	2.12	0.21	2.29	0.55	2.86	0.79	2.18	0.37	1.92	0.59	0.15
Speed (m/sec)	1.54	0.13	1.51	0.18	1.54	0.42	1.29	0.14	1.18	0.11	**0.02***

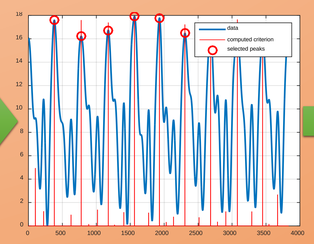
V: Vertical; AP: Anterior posterior; ML: Medial lateral; SD: Standard Deviation. *p <0.05.

Figure 1: Signals recorded by the X16-mini accelerometer.



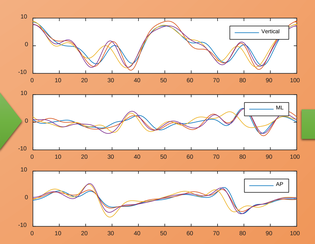
The raw signals are processed and filtered to obtain the 3-component (Vertical, ML, and AP) of gait.

Figure 2: Step detection for gait analysis.



The peak detection allows the signal segmentation to obtain the steps.

Figure 3: Gait components for each step.



Applying the Fourier Transform the frequency components of each step are obtained. The HR is calculated from the amplitudes of the even and odd frequencies.

Figure 4: Frequency analysis.