



QUANTIFYING GAIT IMPAIRMENT IN INDIVIDUALS AFFECTED BY CHARCOT-MARIE-TOOTH DISEASE: THE USEFULNESS OF GAIT PROFILE SCORE AND GAIT VARIABLE SCORE.

Abstract

Background: Gait analysis (GA) is a valid tool in Charcot-Marie-Tooth (CMT), but the complexity of output makes its use difficult. Synthetic measures, namely the gait profile score (GPS), a single score that summarizes the joint kinematics (expressed by the Gait variable score (GVS)), may be a valid approach.

Aims: To test the usefulness of GPS and GVS as a method to quantify and monitor gait impairment in CMT.

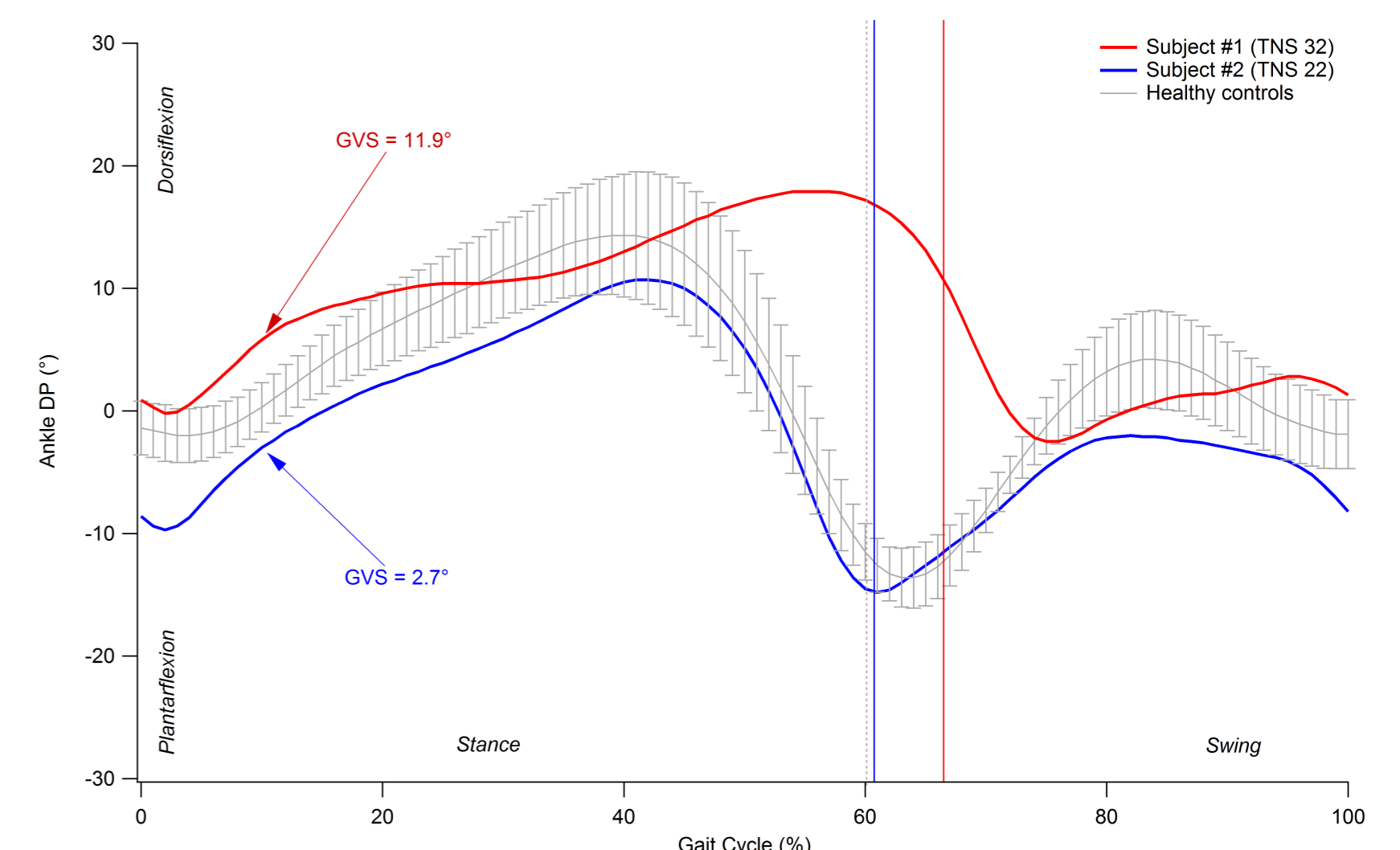
Methods: A group of CMT patients and a gender-age-matched control group (CG) was recruited. GA was performed and spatio-temporal parameters, kinematics and dynamic range of motion (ROM) were calculated. The neurological impairment was evaluated by means of CMT neuropathy score (CMTNSv2) and Total Neuropathy Score (TNS).

Differences in the spatio-temporal parameters, GVS and GPS scores and ROM induced by the pathology were assessed using MANOVA. The relationship between spatio-temporal and kinematic parameters CMTNSv2 and TNS was assessed by the Pearson correlation.

GPS and GVS scores

	CMT		CG		Status p-value	Limb p-value
	Left	Right	Left	Right		
GPS (°)	8.55 ± 1.81	8.04 ± 2.42	6.01 ± 1.29	7.33 ± 2.02	0.002*	0.418
Pelvic Tilt	4.89 ± 2.90	4.89 ± 2.70	3.97 ± 2.34	4.48 ± 2.73	0.134	0.889
Pelvic Rotation	4.18 ± 1.36	4.28 ± 1.55	3.76 ± 1.73	3.41 ± 1.66	0.117	0.751
Pelvic Obliquity	2.18 ± 0.54	2.51 ± 0.56	2.22 ± 1.29	2.04 ± 0.94	0.357	0.773
Hip Flexion-Extension	9.25 ± 5.52	9.08 ± 3.80	7.36 ± 4.51	9.53 ± 5.26	0.564	0.427
GVS (°)						
Hip Abduction-Adduction	3.93 ± 2.03	4.48 ± 2.05	4.28 ± 1.76	3.29 ± 1.24	0.374	0.643
Hip Rotation	9.16 ± 4.58	8.52 ± 4.54	7.65 ± 3.28	10.12 ± 5.67	0.969	0.444
Knee Flexion-Extension	10.84 ± 3.15	10.39 ± 4.80	7.83 ± 2.94	10.20 ± 4.71	0.127	0.356
Ankle Dorsiflexion	9.07 ± 3.96	8.63 ± 4.18	4.50 ± 1.31	6.38 ± 1.79	<0.001*	0.368
Foot Progression	11.99 ± 6.84	11.83 ± 6.17	5.35 ± 2.53	6.96 ± 3.03	<0.001*	0.608

CMT: Charcot-Marie-Tooth, CG: Control Group. The symbol * denotes statistical difference after Bonferroni correction



Spatio-temporal Parameters

GPS and GVS

Parameter	r		p-value	
	r	p-value	r	p-value
Stride length	-0.75	0.003*	GPS	0.48 0.100
Gait speed	-0.80	0.001*	Pelvic Tilt	0.10 0.738
Cadence	-0.63	0.020*	Pelvic Rotation	0.34 0.258
Step width	0.06	0.833	Pelvic Obliquity	0.60 0.032*
Stance phase	0.31	0.300	Hip Flexion-extension	0.57 0.041*
Swing phase	0.45	0.124	Hip Abduction-adduction	0.23 0.455
Double support time	0.57	0.046*	Hip Rotation	0.01 0.989
			Knee Flexion-extension	0.37 0.216
			Ankle Dorsi- and Plantar-Flexion	0.57 0.043*
			Foot Progression	0.56 0.047*

Total Neuropathy Score (TNS) vs.

Spatio-temporal Parameters

GPS and GVS

Parameter	r		p-value	
	r	p-value	r	p-value
Stride length	0.40	0.166	GPS	0.44 0.135
Gait speed	0.34	0.250	Pelvic Tilt	0.25 0.408
Cadence	0.14	0.634	Pelvic Rotation	0.35 0.237
Step width	0.15	0.631	Pelvic Obliquity	0.55 0.051
Stance phase	0.09	0.748	Hip Flexion-extension	0.23 0.446
Swing phase	0.19	0.540	Hip Abduction-adduction	0.32 0.290
Double support time	0.57	0.050	Hip Rotation	0.20 0.512
			Knee Flexion-extension	0.46 0.118
			Ankle Dorsi- and Plantar-Flexion	0.206 0.501
			Foot Progression	0.18 0.553

CMTNS vs.

The symbol * denotes statistical significance (p<0.05)

The symbol * denotes statistical significance (p<0.05)

Results: Fifteen patients were enrolled, seven female, eight male (mean age 51.5 ±13.4 years,). MANOVA revealed a significant effect of pathology on spatio-temporal parameters (p < 0.001) and GPS (p = 0.002), and no significant effects of dynamic ROM. Also, increased GVS of ankle dorsi-plantar-flexion (p<0.001) and foot progression (p<0.001) was found.

TNS is positively correlated with a GVS of: pelvic obliquity (r=0.60, p=0.032), hip flexion-extension (r=0.57, p=0.041), ankle dorsi-plantar-flexion (r=0.57, p=0.043) and foot progression (r=0.56, p=0.047). No significant correlations were found for CMTNSv2.

Conclusion: The GPS (and GVS) scoring system is a synthetic index able to quantify the dynamic postural impairment in CMT.