Spatio-temporal gait parameters change differently according to speed instructions and walking history in MS patients with different ambulatory dysfunction

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BACKGROUND

Walking dysfunction is common in persons with Multiple Sclerosis (pwMS) and has an impact on the related quality of life. Besides, subjective and motor fatigue are also highly prevalent.
Subjective fatigue is known to increase during the day, but this diurnal pattern has no impact on the maximal walking capacity as measured with the six minutes walking test (6MWT)[1]. However, performance on the 6MWT is known to decline between first and last minute in persons with more severe ambulatory dysfunction [2-3] Changes in walking pattern have not yet been investigated.
Another issue in walking assessment is whether pwMS should be asked to walk at usual or maximal speed. Test format instructions are known to impact on the gait speed results, most pronounced in persons with mild ambulatory dysfunction (EDSS < 4).

OBJECTIVE

The aim of the study was to investigate the impact of

- Gait speed instructions (usual versus fast)
- 2 and 6 minutes walking (fastest speed)

on the gait pattern in pwMS with different degree of ambulatory impairment.

METHODS

27 participants, divided in three groups based on usual gait speed:

- Most Limited Community Walkers; MLCW: <0.82 m/s. n=7
- Limited Community Walkers: LCW: between 0,82 - 1.14 m/s. n=11
- Community Walkers: CW >1,14m/s. n=7

PwMS performed the 2MWT and 6MWT in randomised order. Before and after each test, they walked on the GAITRite walkway system at both usual and fastest speed. Spatio-temporal gait parameters were measured and analyzed with ANOVA.

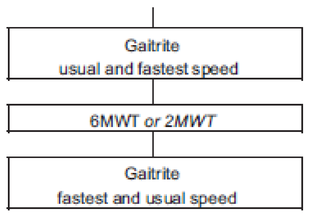
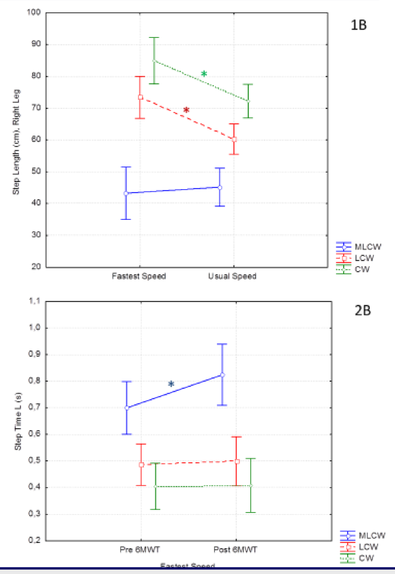


Fig. 1 Flow chart of the experimental design.

Poster reference: Feys et al. Spatio-temporal gait parameters change differently according to speed instructions and walking history in MS patients with different ambulatory dysfunction. Multiple Sclerosis & Related Disorders 2013



RESULTS

Table 2 Spatio-parameters gait parameters (mean±SD; range) in different groups for usual and fastest speed.

Variable	*Speed*	Group MLCW	Group LCW	Group CW	*P*-Value Group	*P*-Value Speed	*P*-Value Interaction
Velocity (m/s)	*Usual* †, ¥, §	0.56±0.17 (0.33-0.82)	1.01±0.11 (0.86-1.13)	1.37±0.22 (1.16-1.81)	<0.001	<0.001	<0,01
	Fastest †, ¥, §	0.73±0.23 (0.39-1.18)	1.62±0.47 (1.07-2.55)	2.14±0.30 (1.66-2.54)			
Cadence (steps/min)	*Usual* †, ¥	73,83±19,08 (48.4-100.6)	101,83±11,91 (79.9-121.7)	113,31±6,05 (104.4-120.7)	<0.0001	<0.0001	ns
	Fastest †, ¥	92.36±20.53 (55.9-120.0)	132.93±29.27 (88.8-196.4)	151.08±18.71 (128.3-182.5)			
Step length (cm), Left	*Usual* †, ¥, §	45.79±5.46 (35.73-53.40)	59.32±6.55 (49.01-67.07)	72.69±7.98 (64.97-88.40)	<0.0001	<0.0001	<0.05
	Fastest †, ¥, §	49.30±9.98 (35-65.21)	72.59±12.17 (59.69-98.05)	84.94±7.93 (72.31-96.19)			
Step length (cm) right	*Usual* †, ¥, §	45.17±5.46 (35.73-53.40)	60.23±6.10 (48.37-67.01)	72.23±10.32 (61.82-91.10)	<0.0001	<0.0001	<0.01
	Fastest †, ¥	43.27±11.18 (28.61-62.78)	73.43±11.62 (59.73-98.84)	84.89±8.41 (78.44-101.48)			
Step time (s), left	*Usual* †, ¥	0.53±0.05 (0.40-0.63)	0,59±0.08 (0.47-0.74)	0.64±0.46 (0-1.39)	0.07	ns	ns
	Fastest	0.4±0.05 (0.32-0.49)	0.48±0.09 (0.37-0.70)	0.69±0.21 (0.48-1.11)			
Step time (s), right	*Usual* †, ¥	0.52±0.04 (0.47-0.6)	0.58±0.05 (0.51-0.68)	0.71±0.41 (0-1.09)	<0.01	<0.05	ns
	Fastest †	0.4±0.04 (0.33-0.46)	0,47±0,08 (0,38-0,65)	0,66±0,18 (0,48-1,03)			
Double support time (%) L	*Usual* †, ¥	26.5±5.13 (21-23.5)	31.63±3.51 (26.8-38.1)	46.83±11.36 (33.4-68.9)	<0,001	<0,001	ns
	Fastest †, ¥	21.1±4.8 (13.2-29)	25.09±4.29 (17-30.2)	40.24±11.47 (27.3-61.4)			
Double support time (%) R	*Usual* †, ¥	27.15±4.79 (21.2-33.4)	31.62±3.77 (26.7-38.6)	46.42±9.98 (32.2-64.3)	<0.001	<0.001	ns
	Fastest †, ¥	21.06±4,43 (21.2-29)	25.5±3.94 (18-31)	40.67±12.13 (27.3-63.4)			

Significant difference beween MLCW and LCW (†), MLCW and CM (¥), LCW and CW (§).

Table 2.

Significant differences were present between the three ambulation groups for all spatio-temporal gait variables except of step time of the left leg.

Speed instructions overall impacted on the gait pattern except for step time left.

Table 3 The impact of 2MWT and 6MWT on spatio-temporal parameters for different ambulation groups walking at usual and fastest speed.

			MLCW (n=9)			LCW (n=11)			CW (n=7)		
Variable		Test	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
Velocity (m/s)	2MWT	Usual	0.53	0.53	0.00	1.03	1.05	0.02	1.39	1.47	0.08
		Fastest	0.68	0.69	0.01	1.57	1.57	0.00	2.11	2.11	0.00
	6MWT	Usual	0.59	0.56	−0.03	1.04	1.05	0.01	1.40	1.40	0.00
		Fastest	0.77	0.66	−0.11	1.58	1.49	−0.09	2.12	2.10	−0.02
Cadence (steps/min)	2MWT	Usual	72.89	73.83	0.94	87.48	84.89	−2.59	85.13	73.70	−11.43
		Fastest	87.48	84.89	−2.59	132.24	128.19	−4.05	149.79	147.74	−2.05
	6MWT	Usual	85.13	73.70	−11,43*	103.24	102.85	−0.39	113.84	112.99	−0.85
		Fastest	94.38	80.81	−13.57***	128.16	126.50	−1.66	150.06	147.43	−2.63
Step length L (cm)	2MWT	Usual	42.82	44.74	1.93	60.57	60.71	0.14	72.90	75.23	2.33
		Fastest	46.69	48.46	1.78	70.62	72.77	2.14	83.93	85.63	1.70
	6MWT	Usual	42.92	45.15	2.23	59.89	60.72	0.83	74.80	74.37	−0.43
		Fastest	50.11	49.36	−0.75	73.74	70.35	−3.40	84.91	85.23	0.32
Step length R (cm)	2MWT	Usual	44.01	40.87	−3.15	61.13	60.90	−0.22	73.02	74.78	1.76
		Fastest	43.87	47.14	3.27	71.25	72.23	0.98	85.17	85.27	0.10
	6MWT	Usual	42.66	42.71	0.05	61.04	61.23	0.19	72.71	73.54	0.83
		Fastest	44.44	46.66	2.22	73.24	68.49	−4.75	84.54	86.32	1.78
Step time L (s)	2MWT	Usual	0.53	0.52	0.03	0.61	0.60	−0.01	0.89	0.92	0.03
		Fastest	0.41	0.41	−0.10	0.48	0.49	0.01	0.75	0.65	−0.10
	6MWT	Usual	0.53	0.53	0.18	0.59	0.60	0.01	0.65	0.83	0.18
		Fastest	0.40	0.41	0.124*	0.49	0.50	0.01	0.70	0.82	0.12
Step time R (s)	2MWT	Usual	0.53	0.51	−0.11	0.59	0.57	−0.02	0.89	0.78	−0.11
		Fastest	0.40	0.41	−0.13	0.47	0.48	0.01	0.74	0.61	−0.13
	6MWT	Usual	0.52	0.53	0.17	0.58	0.58	0.00	0.71	0.88	0.17
		Fastest	0.40	0.42	0.11**	0.48	0.49	0.01	0.67	0.78	0.12
Double support time L (%)	2MWT	Usual	27.43	27.26	−0.17	31.14	31.50	0.36	46.67	48.69	2.02
		Fastest	22.03	21.10	−0.93	27.04	26.12	−0.92	45.33	44.30	−1.03
	6MWT	Usual	26.50	26.86	0.36	31.63	32.03	0.40	46.83	48.63	1.80
		Fastest	21.10	22.65	1.55	25.09	26.6	1.51	40.24	41.54	1.30
Double support time R (%)	2MWT	Usual	27.72	26.81	−0.91	30.98	32.11	1.13	46.54	47.39	0.85
		Fastest	21.54	21.06	−0.48	27.21	26.12	−1.09	45.52	44.41	−1.11
	6MWT	Usual	27.15	27.41	0.26	31.62	32.21	0.59	46.42	47.39	0.97
		Fastest	21.06	21.11	0.05	25.5	27.58	2.08	40.67	40.43	−0.24

*$p<0.01$
**$p<0.001$
***$p=0.06$

Table 3.

The impact of speed instruction was however different for the three ambulation groups for the variables gait velocity and step length. Figure 1B illustrates the impact of speed instruction for step length: the most limited community walkers were not able to increase step length when asked to walk as fast as possible in contrast to the other ambulation groups.

The impact of walking history, being either 2 or 6 minutes walking at fastest speed, had no impact at all on the gait pattern in the (limited) community walkers groups walking at least >0,82m/s.

The most limited community walkers, however, showed a reduced cadence at usual speed and reduced step length at fastest speed after walking the 6MWT. Any impact of the 2MWT was found in any group.

DISCUSSION & CONCLUSION

The ability to accelerate was dependent on the severity of ambulatory dysfunction. One may advice to include both speeds when measuring the effects of rehabilitation interventions as acceleration may be considered as an important ability during outdoor mobility.
Prolonged walking during the 6MWT has, in contrast to the 2MWT, some impact on gait parameters in the most disabled group only. This confirms clinical observations that the 6MWT can be experienced as exhausting in persons with severe ambulatory dysfunction. For testing of walking speed, one may consider to apply the 2MWT instead which was shown to be more closely correlated to the 6MWT than the T25FW. [4].

References

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