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Clinical Outcome Measures

Individual variation of gait parameters along a 500 meter walk in people with multiple sclerosis and healthy volonteers

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Background and Aims

We previously demonstrated the usefulness of the Deceleration Index (DI, the ratio between the last 100m of the Timed 500-Meter Walk test –T500MW – and the walking speed - WS – of the Timed 25-Foot Walk Test with a propelled start – T25FW$^+$) to evaluate motor fatigue over a long walking distance in people with multiple sclerosis (pwMS)[1]. We also recently designed[2] and internally validated a new gait analysis tool for pwMS (GAIMS) that can measure other relevant gait characteristics than the sole WS, such as ataxia, asymmetry of leg movement and perhaps spasticity[3].

Our **Aims** were**:** (i) To compare various gait characteristics between the last and the first 100m of a 500m distance (i.e., the T500MW) in a population of pwMS and healthy volunteers (HV), (ii) to compare the ratio between the last and the first 100m of the T500MW with the DI, and (iii) to investigate their relationship with the EDSS in pwMS.

Methods

- This study was approved by the local ethics comittee
- **Seventy-one pMS and 157 HV** were recruited
- The design was cross-sectional

Walking Tasks

- The subjects were asked to walk along **two trajectories** in the GAIMS system which uses Range Laser Scanner (RLS) technology: (i) a straight line of 9,62m (i.e. 25 feet + 2m) and (ii) a 8-shaped figure of 20m (Fig 1)
- The evaluation was part of a multimodal evaluation including **four walking tasks and three walking modes.** The current study was performed with the data collected from the **Timed 25-Foot walk with a propelled start (T25FW$^+$)** and the **Timed 500-Meter walk (T500MW)** which were both performed « **as fast as possible** »

RLS-derived gait descriptors

- Twenty-six gait descriptors are extracted and quantified from the recorded foot paths
- A crude dichomization was applied by separating **efficiency of gait descriptors** (EG), i.e. directly implicated in walking speed from **quality of gait descriptors** (QG), i.e. without any direct relation to walking speed but perhaps related to other gait feature such as balance and proprioception
- **EG** included mean walking speed, mean/maximum left/right foot speed, gait cycle time while **QG** included mean, maximal and RMS deviation from the path, mean interfeet distance, mean lateral interfeet distance, double/single limb support time, variability of left/right foot trajectory and step length asymmetry
- The **Deceleration Index (DI)** was calculated as the ratio between the WS of the last 100m of the T500MW over the WS of of the T25FW$^+$

Statistical analysis

- Paired Student's t-tests were performed on various gait characteristics extracted during the first and last 100m ot the T500MW in HV and pwMS stratified according to their DI (considered high if ≥ 0.8, MSH or low if < 0.8, MSL). The analysis was also performed on the whole pwMS population (MSA)
- Pearson's correlation coefficient (r) was calculated between these ratios and subject's EDSS.
- We chose .05 as a level of significance and analysis were performed using the function « Pearson_test » bundled with Octave (http://www.gnu.org/software/octave/) version 3.2.4

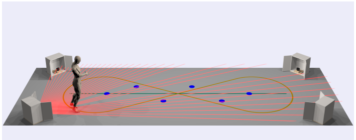


Figure 1 ***Example of feet path recorded along a lap of 20m along the 8-shaped trajectory***

Results

Gait characteristics differences between the first and last 100m of the T500MW (Fig 2 and 3)

In HV (n=157, Fig 2A), MSA (n=71, Fig 2B), MSH (n=36, Fig 2C) and MSL (n=35, Fig 2D), significant differences were observed for speed related gait characteristics between the last and first 100m of the T500MW. Gait characteristics related to ataxia and precision of foot placement, here exemplified by the mean distance between feet (Fig 3A and 3B, showing the HV and MSA group results, respectively). Interestingly, although the differences were significant for both group, they appeared much more pronounced in the MS group

Correlation between the ratio of the first and last 100m of the T500MW, and the Deceleration Index

For the whole population and for pwMS analysed as a whole, a strong positive correlation was observed between the WS ratio of the last and first 100m of the T500MW and the DI (Fig 4A, p < 0.001; r = 0.57 and 0.62, respectively).

Although moderate, the negative correlation between the last/first 100m of the T500MW with the EDSS appeared slightly stronger than the one between the DI and the EDSS (Fig 4B and C, p<0.001 for both analyses, r = -0.47 and r = 0.37, respectively)

Comparison between speed related gait characteristics of the first and last 100m of the T500MW in HV (A), all pwMS (B), pwMS with a high DI (C) and pwMS with a low DI (D).

Figure 2

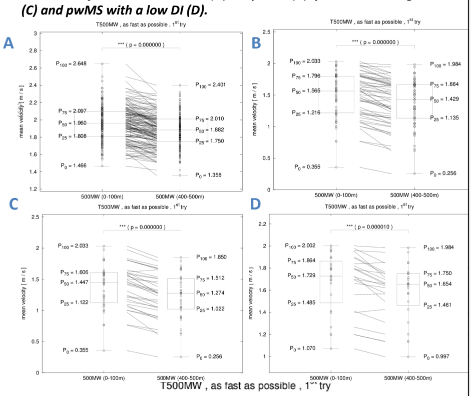
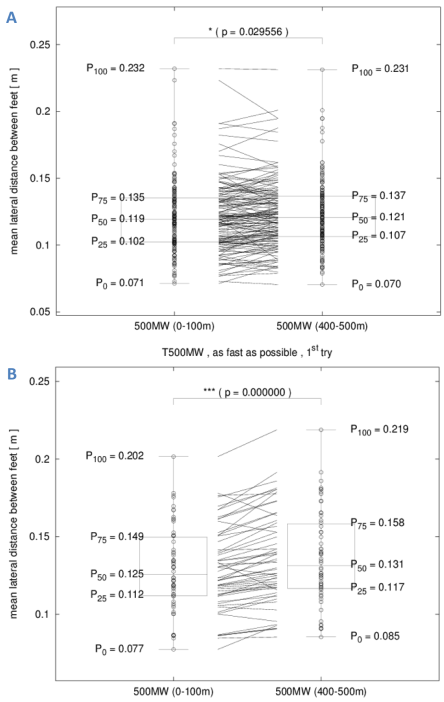


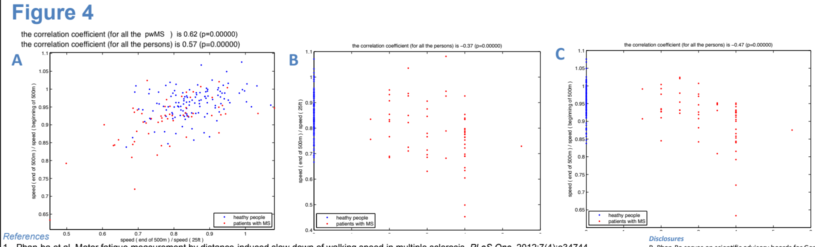
Figure 3



Conclusion – Discussion – Perspectives

- As previously demonstrated, we here confirm that alongside to WS, there are other gait features affected by locomotor fatigue over a long walking distance
- Once again, we show in Figure 3 that although speed may decrease significantly both in healthy subjects and pwMS, the gait disorder of MS distinguishes itself by specific features, such as an increased lateral distance between feet.
- The strong positive (although not *very* strong) correlation between the DI and the last/first 100m of the T500MW indicates that these measures are not exactly the same and that next to a short distance walking test such as the T25FW, a long one such as the T500MW remains useful
- The last/first 100m of the T500MW is better correlated to the EDSS and might be a better predictive tool of pwMS' neurologic state than the DI.

Figure 4



References

1. Phan-ba et al. Motor fatigue measurement by distance-induced slow down of walking speed in multiple sclerosis. *PLoS One.* 2012;7(4):e34744
2. Pierard et al. A new low cost non intrusive feet tracker. *Workshop on Circuits, Systems and Signal Processing (ProRISC).* 2011 Nov: 382-7
3. Relative contribution of Walking Speed, Ataxia and Gait asymmetry to the composition of Gait in Multiple Sclerosis. *Poster presented at the ECTRIMS meeting 2012, Copenhagen, Danemark.* 2010 Jul;32(3):332-5

Disclosures
R. Phan-Ba serves on scientific advisory boards for Genzyme-Sanofi Aventis and has received funding for travel from Genyzme-Sanofi Aventis, Bayer Schering Pharma and Biogen Idec.
S. Pierard and M. Van Droogenbroeck have nothing to disclose.