mixed model was adopted to perform statistical analysis using R software (R-Core Team., Austria, 2017)

Results: Error in stance and swing time detection significantly increased from hard surface (Stance Dm 56ms; Swing Dm: 55ms) to wet (59ms; 56ms) and dry sand (137ms; 138ms) condition. Conversely, no difference was found in stride and step detection errors (Fig. 1a). Successively, the estimated stride and step time were found to be different across all conditions increased from hard surface to dry sand (Fig. 1b).

Discussion: Even though errors in stance and swing time tended to triple from hard surface to dry sand condition, preliminary accuracy results suggest that the use of IMUs for the estimation of GTPs can be adopted in gait performance assessment. Findings from this study warned to be cautious on the interpretation of increasing trend associated to stance and swing time across different conditions, since this variation resulted to be lower than accuracy in their estimation. Future research will focus on assessing more accurate methods to obtain a comprehensive characterization of WOS in real and ecological conditions.

References

[1] Pinnington H, et al. Sci Med Sport 2001;4:416–30.
[2] Van Den Berg EL, et al. Multiple Sclerosis and Related Disorders 2017;16:15–21.
[3] Chen H. Clinical Biomechanics 1995;10:271–4.
[4] Lejeune TM. The Journal of Experimental Biology 1998;201:2071–80.
[5] Salarian A, et al. Trans. Biomed. Eng 2004;51:1434–43.

https://doi.org/10.1016/j.gaitpost.2018.07.146

Effects of short pulse-width stimulation on gait ataxia of Essential Tremor patients implanted with thalamic Deep Brain Stimulation

C. Palmisano [1,2], M. Reich [1], J. Volkmann [1], C.A. Frigo [2], I.U. Isaias [1]

[1] *University Hospital and JMU Wuerzburg, Wuerzburg, Germany*
[2] *Politecnico di Milano, Milan, Italy*

Introduction: Deep Brain Stimulation (DBS) of the Subthalamic nucleus (STN) is a well-established and effective treatment for disabling and drug-refractory essential tremor (ET), but it can lead in some cases to a delayed onset cerebellar syndrome (e.g. ataxia), possibly caused by a maladaptive response to the neurostimulation of the thalamic area. In this study we investigated the effect of stimulation pulse- width on gait ataxia of ET patients. We envisioned that short pulse-width (30 μs) could prevent gait disturbances in ET patients by selective neurostimulation only of fast conducting dentate-thalamic myelinated fibers, thus ensuring tremor suppression but without ataxia symptoms.

Methods: We enrolled 7 patients (2 M, age: 73(65 ± 86) years) with pharmacologically intractable ET and gait progressive ataxia with bilateral DBS implant of the STN area. Patients were studied under two stimulation conditions: at the baseline, with their usual stimulation parameters, and at 2-week follow- up after reducing the pulse-width to 30 μs. The protocol included a clinical evaluation with the Fahn-Tolosa-Marin tremor rating scale (TRS) and the SARA scale for ataxia (items 1-3) and a kinematic assessment of locomotion. Subjects were instructed to perform at least 5 walking trials (8 m each) in a gait laboratory environment walking barefoot at their preferred speed. Kinematics was recorded with an optoelectronic system (SMART DX, BTS) and gait spatio-temporal parameters were calculated with ad hoc Matlab algorithms. We averaged the parameters across trials and calculated the coefficient of variation (CV, the ratio between the standard deviation and the average value) as an index of parameter variability. The baseline and ataxic conditions were compared with a Wilcoxon matched pairs test (JMP13).

Table 1
Gait parameters. All comparisons are statistically significant ($p < 0.05$) except for the CV of stride velocity. BH: body height.

Median (range) of Means		
Parameters	Baseline	Follow-up
Stride duration (s)	1.21 (1.04 – 1.52)	1.17 (1.01 – 1.24)
Stride length (%BH)	50.73 (36.28 – 62.31)	58.39 (41.11 – 70.48)
Stride velocity (%BH/s)	36.89 (31.90 – 59.32)	48.71 (33.86 – 65.65)
Double support duration (%stride)	34.15 (24.35 – 39.79)	30.30 (18.77 – 35.57)
Median (range) of CVs		
Parameters	Baseline	Follow-up
Stride duration (s)	0.06 (0.04 – 0.10)	0.04 (0.03 – 0.07)
Stride length (%BH)	0.07 (0.04 – 0.15)	0.05 (0.03 – 0.06)
Stride velocity (%BH/s)	0.09 (0.05 – 0.17)	0.07 (0.05 – 0.11)
Double support duration (%stride)	0.14 (0.11 – 0.17)	0.11 (0.09 – 0.16)

Results: Short pulse-width (30 μs) remarkably improved gait ataxia, as shown by the clinical scale (SARA1-3 baseline score: 6.8 ± 2.8; follow-up score: 3.0 ± 2.0; $p < 0.01$) and the kinematic parameters (Table 1). Of note, tremor was always well controlled by DBS (TRS baseline score: 10.2 ± 9.5; follow-up score: 4.8 ± 4.2; p = n.s.).

Discussion: DBS-induced gait ataxia in ET patients can be well managed by reducing the stimulation pulse-width to 30 μs. Such a short pulse-width might allow the stimulation of the only fast conducting dentate- thalamic myelinated fibers, the proper target for tremor control, preventing current spread responsible for the cerebellar side effects. Of note, the reduction of the pulse-width does not alter the tremor suppression, which was well controlled also in this stimulation condition.

https://doi.org/10.1016/j.gaitpost.2018.07.147

Can be a subjective qualitative evaluation reliable to assess the perceived physical status and the level of the performance in élite sprinters with Intellectual Impairments?

A. Palomba [1,*], T. Caporaso [2], S. Grazioso [2], G. Di Gironimo [2], A. Lanzotti [2], G. Iolascon [1], R. Gimigliano [1], F. Gimigliano [3]

[1] *University of Campania "L. Vanvitelli", DMSSD, Naples, Italy*
[2] *Fraunhofer JL IDEAS, DII – University of Naples "Federico II", Naples, Italy*
[3] *University of Campania "L. Vanvitelli", DMPHPM, Naples, Italy*

Introduction: Training programs for athletes are usually based on quantitative objective performance measures and qualitative subjective feedback coming from the athletes. However, it is difficult to have reliable qualitative feedback when the athletes are affected by Intellectual Impairments (II). The current practice is to perform a functional evaluation to assess quantitative performance measures. Previous studies suggested the use of wearable devices to evaluate and correlate physical and mental functions in II subjects [1]. The aim of this study is to clarify whether a simplified version of the Smiley Face Likert Scale (SMLS) [2] might be adequate to self-assess the perception of the II subjects of their physical status after the test and of the level of their performance when compared to objective measures such as the metabolic and kinematic analyses.

Methods: Three male sprinters, members of the national team of the Italian Federation for Athletes with Intellectual Impairments, were tested. After 20' of warm up, they were asked to perform 2 series of 4 sprints each on 80-meters distance, as fast as possible. During the experiments, we used photocells to measure the duration of the test and a triaxial inertial sensor was placed at the L5

Table 1
Kinematics and metabolic parameters of the three subgroups for Ph and P status (mean ± SD). Statistical significant differences between subgroups 1-2(*), 1-3(**) and 2-3(***), $p < 0.05$).

Groups	v [m/s]	f [step/s]	ρ [m]	u [-]	lac [mmol/l] (*,**)
Ph1	8,40±0,50	3,92±0,18	2,14±0,04	4,90±0,61	7,47±3,84
Ph2	8,33±0,34	3,90±0,16	2,14±0,01	4,98±0,74	15,33±2,46
Ph3	8,15±0,21	3,88±0,10	2,12±0,02	5,22±0,71	17,70±3,58
Groups	**v [m/s] (*,**,***)**	**f [step/s] (*,**,***)**	**ρ [m] (*,**)**	**u [-]**	**lac [mmol/l]**
P1	8,78±0,25	4,07±0,11	2,16±0,02	5,09±0,41	11,70±5,20
P2	8,25±0,10	3,88±0,08	2,13±0,02	5,23±0,72	17,97±3,47
P3	7,94±0,08	3,76±0,04	2,12±0,02	4,74±0,79	10,57±5,54

vertebra, to record four spatial-temporal parameters, for each of the 24 sprints: velocity (v); step frequency (f); step length (ρ); smoothness performance index by normal jerk (μ) [3,4]. The metabolic assessment was reached through lactate (*lac*) measurement six times during each test: at baseline, every 2 sprints and after 5' recovery from the last sprint. Furthermore, the athletes were asked to report a subjective evaluation on their physical status (Ph) and on the level of the performance (P), based on the simplified version of the SMLS, composed by three faces (good = 1, neutral = 2, bad = 3), after each sprint. The statistical analysis compared different groups according to their perceived physical status (Ph1, Ph2, and Ph3) and to their perceived level of performance (P1, P2, and P3). The one-way ANOVA and the Tukey test ($p < 0.05$) were used to assess the significant differences between the groups.

Results: Table 1 shows the results: the physical status (reported as good) was significantly correlated with lower levels of lactate as well as better kinematics parameters were found in cases where the II athletes stated their performance as good.

Discussion: A simplified version of the SMLS might be useful to help élite II athletes to communicate their physical condition after any athletic training or competition and their perceived level of performance. Further studies will be necessary to verify the reliability of the simplified version of the SMLS and eventually to standardize it. However, the metabolic and kinematic evaluation still remain the only reliable analysis, to ensure the best performances without compromising the safety of the II athletes.

References

[1] Caporaso T, et al. Gait&Posture 2017;57:25–6.
[2] Hall L, et al. Proc.15th Intern. Conference on Interaction Design and Children 2016:311–21.
[3] Bergamini E, et al. Journal of biomechanics 2012;45(6):1123–6.
[4] Balasubramanian S, et al. IEEE Transactions on Biomedical Eng 2012;59(8):2126–36.

https://doi.org/10.1016/j.gaitpost.2018.07.148

Preliminary comparison between actigraphic measures and sleep diary reports in people with Mild Cognitive Impairment

S. Pancani, L. Fabbri, L. Martini, I. Mosca, F. Gerli, F. Vannetti

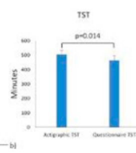
Don Carlo Gnocchi Foundation, IRCSS, Italy

Introduction: Mild cognitive impairment (MCI) is the transitional state between intact cognitive function and mild dementia [1]. Poor cognitive functioning has been shown to introduce a bias in estimating sleep duration [2], which indeed needs a careful assessment as it has important implication on cognitive decline. The use of actigraphic measures might thus represent a viable and relatively inexpensive alternative to sleep diaries. This study is a preliminary investigation on subjective-actigraphic sleep discrepancy in people with MCI.

Methods: Five subjects with MCI, aged 70–79 years, wore an actigraph (GENEActiv, Activinsights, United Kingdom) and kept a sleep diary for ten consecutive nights. Baseline data on subjective sleep quality (scale range: 1, very poor, to 5, very good), number of awakenings (minimum 5 minutes duration of the awake phase), depressive symptoms and cognitive functioning were also recorded. To discriminate between wake and sleep status from acceleration data measured by the device, activity counts were estimated using the zero-crossing technique [3]. Activity counts were then collapsed in 1- minute epochs and used in the algorithm proposed by Sadeh et al. for sleep-wake identification [4]. A Student t-test for paired samples (significance $p < 0.05$) was used to compare total sleep time (TST) and number of awakenings estimated by the actigraphic data and reported by patients on diaries.

Subject	1	2	3	4	5
Actigraphic bed time	22:59 ± 00:11	23:28 ± 00:23	00:08 ± 00:34	1:08 ± 00:20	23:26 ± 00:28
Actigraphic get up time	08:04 ± 00:19	08:00 ± 00:52	08:36 ± 00:13	08:45 ± 00:54	07:41 ± 00:27
Subjective sleep quality (score)	4.2 ± 0.4	2.5 ± 0.5	2.6 ± 0.7	2.5±0.5	3.2 ± 0.6
Actigraphic nr of awakenings	0.8 ± 0.4	1.7 ± 1.0	1.7 ± 0.9	1.5 ± 0.7	1.1 ± 0.7
Diary nr of awakenings	0.3 ± 0.5	2.9 ± 1.0	1.2 ± 0.4	1.4 ± 0.5	1.1 ± 0.5
Gender	F	M	F	F	M
Age (years)	70	70	79	74	78
Education (years)	6	15	5	8	18
Use of sleep medication (y/n)	n	y	y	n	y
CES-D (score)	11	21	31	24	18
MoCA (score)	21.03	18.88	22.38	22.29	28.77
Recall of Rey's figure (score)		12.1	17	22.25	10.69
Stroop-errors interference effect (score)	28.32	1.1	0	0	0
Phonemic fluency (score)	33.93	28.71	53.23	35.9	46.06

a)



b)

Fig. 1. Characteristics of the study sample presented as mean ± SD (CES-D center for epidemiological studies depression, MoCa: Montreal cognitive assessment); B) Actigraphyc and subjective estimation of total sleep time (TST).

Results: Demographic and clinical characteristics of the five participants are reported in Fig. 1a together with sleep parameters measured by the actigraph and recorded on diaries, averaged over ten nights. No significant difference ($p = 0.935$) was found in the assessment of number of awakenings while a significant discrepancy was found in the estimation of TST ($p = 0.014$, Fig. 1b). Participants reported an overall poor (score 2) to fair (score 3) sleep quality.

Discussion: Participants presented a significant underestimation of sleep time, confirming a mismatch between subjective reports and objective measurements. The reported poor quality of sleep needs further examination by assessing additional sleep parameters, such as the sleep-onset latency. Results obtained in this preliminary study are sufficiently encouraging to warrant a further investigation, which will be conducted on a larger sample of 12 subjects, on clinical characteristics assessed at the baseline as possible determinants of the observed disagreement and reported poor quality of sleep.

References

[1] Petersen RC. J Intern Med 2004;256(3):183–94.
[2] Van Den Berg JF, et al. J Sleep Res 2008;17(3):295–302.
[3] Aktaruzzaman, et al. Comput Biol Med 2017;89:212–21.
[4] Sadeh A, et al. Sleep 1994;17:201–7.

https://doi.org/10.1016/j.gaitpost.2018.07.149

Robotic rehabilitation effect on upper limb recovery in post-acute stroke

D. Quaglia*, M. Gasperi, R. Coser, G. Grisenti, M. Scartozzi, E. Girardi, N. Mazzini

Villa Rosa Rehabilitation Hospital–APSS Trento, Pergine Valsugana TN, Italy

Introduction: In the last decade, neurorehabilitation robotic technologies have become widely spread and scientific evidence of their clinical effectiveness has increased [1]. Functional recovery of the upper limb is one of the main rehabilitation goals for post stroke hemiplegic patients and the use of robotic technologies is recommended in stroke guidelines [2]. The main objective of this study is to evaluate the robotic training effect on the upper limb