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LETTER

Study of intra-subject random variations of stabilometric parameters

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Abstract This study of intra-subject random variations of stabilometric parameters was achieved in the context of the standardized clinical stabilometry, in use in France and Southern Europe since 1985. The outstanding interest of stabilometry to follow up patients makes the results of this study indispensable for clinicians and their international publication is particularly important as, these days, the standardization Committee for clinical stabilometry resumes its work within the International Society for Postural and Gait Research. Such a study is possible only on the topological stabilometric parameters because of the stroboscopic effect on the dynamic parameters of the sampling rate of our computerized measuring chains.

Keywords Stabilometry · Follow up · Repeatability

1 Introduction

The committee commissioned by the international Society of Posturography (now The International Society for Postural and Gait Research (ISPGR)) to standardize the practice of stabilometry resigned during the Houston (Tx) Congress, after having published some useful recommendations but that defined neither the measuring chain, nor the recording conditions, nor the reference values of some stabilometric parameters, nor the repeatability of these parameters [5].

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The 'Association Française de Posturologie' (AFP), mainly composed of clinicians, estimated that the practice of clinical stabilometry in such conditions was just out of the question. Therefore, it decided to write specifications to build a standardized platform for clinical purpose [2], to define recording conditions [1], to give reference values for some stabilometric parameters [1] and to study the repeatability of these parameters. The success of the standardized clinical stabilometry prompts us to publish this last survey as a technical note.

Forty-two young selected subjects were recorded during 4 weeks in strictly identical conditions. The distributions of the intra-subject random variations of stabilometric parameters, observed between two successive measuring at different time intervals, were the subject of a statistical study whose results provide indispensable indications for therapists because of the very major interest of stabilometry to follow up the evolution of the patients.

Only the topological parameters, not modified by the sampling rate [3], were submitted to this statistical analysis. The stroboscopic effect on dynamic parameters, due to the sampling rate, would have obliged to repeat the analysis for all possible cadences [4].

The standardization Committee for clinical stabilometry within the ISPGR having currently resumed its work makes desirable the international publication of the results of this survey, unique in its kind for the range of time intervals it explores.

2 Methods

2.1 Subjects

Forty-two subjects, paid, were selected on history, clinical exam and stabilometric criteria: neither neurological

antecedents, no chronic pain syndrome, no major postural tonic asymmetries during the Fukuda stepping test, values of stabilometric parameters (X-mean, Y-mean, area, LFS, VFY, ANØ2X, and ANØ2Y) inside the statistical limits of normality published in Normes85 [1], in open and closed eyes situation.

Clinical investigations were carried out in accordance with the declaration of Helsinki adopted in 1964, modified at the Hong Kong Congress in 1989.

2.2 Recording

Once a week, on the same day of the week, for 4 weeks, these 42 subjects were hospitalized so that their food as well as the absence of use of medicinal drugs and of tobacco is controlled. They were recorded on a standardized stabilometric platform, in rigorously identical conditions, at various time intervals: 3 min, 3 h, 6 h, 9 h, 7 days, 14 days, and 21 days.

Recordings have been achieved, in open and closed eyes situation, on a force platform built according to the standards of the AFP [2], in the standardized conditions of the AFP: visual target 90 cm away in front of the subject and 50 cm on his sides, with bare feet, fan-shaped at 30°, heels 2 cm apart, arms alongside the body, vigilance supervised thanks to an aloud counting task; the recording lasted 51.2 s, sampling rate 5 Hz [1].

2.3 Stabilometric parameters

Only the stabilometric parameters whose values are not modified by the sampling rate [3] were kept for this study, that is to say: the area of the confidence ellipse containing 90% of the sampled positions of the pressure center [6], the mean position of the pressure center in X and Y, according to the 1981 Kyoto conventions [5].

2.4 Statistical analysis

The effect of the factor time with eight modalities on the three random variables was studied only by a parametric test for a unique sample, the distribution of the matched difference between the values observed at each selected time interval. The study was only aiming at knowing the parameters of the Gaussian curve that characterizes the distribution of each of these paired differences, after having checked that the mean difference was not statistically different from zero. No other statistical analysis was needed to meet the aim of the study.

3 Results and discussion

3.1 Open eyes situation

The values concerning the area parameter are given in Napierian logarithms, because the distribution of the area is Lognormal (Table 1).

Table 1 Mean and standard-deviation of the paired differences observed between the parameters X-mean, Y-mean (real values), and area (Napierian logarithms) of two successive, identical recordings, in eyes open situation, at the various time intervals: 3 min, 3 h, 6 h, 9 h, 8 days, 15 days, and 21 days

Time intervals	3 min	3 h	6 h	9 h	8 days	15 days	21 days
N	168	240	160	80	126	84	42
X-mean	0.18 ± 4.08	0.19 ± 4.23	0.18 ± 4.12	0.21 ± 4.12	−0.07 ± 3.67	0.23 ± 4.09	0.25 ± 3.75
Y-mean	1.12 ± 8.16	0.49 ± 7.61	1.10 ± 8.20	3.04 ± 7.82	−2.04 ± 8.32	3.7 ± 8.12	4.3 ± 8.21
Ln(area)	0.0009 ± 0.4227	0.0005 ± 0.4231	0.0001 ± 0.4249	0.0012 ± 0.4193	0.0005 ± 0.4225	0.0009 ± 0.4249	0.0019 ± 0.4253

N number of measuring for this time interval (unit: mm^2)

Table 2 Mean and standard-deviation of the paired differences observed between the parameters X-mean, Y-mean (real values), and area (Napierian logarithms) of two successive, identical recordings, in eyes closed situation, at the various time intervals: 3 min, 3 h, 6 h, 9 h, 8 days, 15 days, and 21 days

Time intervals	3 min	3 h	6 h	9 h	8 days	15 days	21 days
N	168	240	160	80	126	84	42
X-mean	0.14 ± 3.86	0.15 ± 4.22	−0.17 ± 3.79	0.81 ± 3.82	0.72 ± 4.15	0.84 ± 3.9	0.98 ± 3.91
Y-mean	−1.09 ± 13.99	0.54 ± 7.47	−2.03 ± 12.73	3.24 ± 9.60	−2.57 ± 8.19	−3.12 ± 8.25	4.62 ± 9.59
Ln(area)	0.0006 ± 0.4654	0.0004 ± 0.4656	0.0001 ± 0.4664	0.0001 ± 0.4660	0.0001 ± 0.4661	0.0016 ± 0.4618	0.0031 ± 0.4624

N number of measuring for this time interval (unit: mm^2)

3.2 Closed eyes situation

The values concerning the area parameter are given in Napierian logarithms, because the distribution of the area is Lognormal (Table 2).

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