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Update on multiple sclerosis rehabilitation

Roldano G Cardini*[,1], Alessandro C Crippa[1] and Davide Cattaneo[1]

[1]*Neurological Rehabilitation Service, Don C. Gnocchi Foundation I.R.C.C.S., ONLUS, Via Capecelatro 66, Milan, 20148, Italy*

The neuromotor rehabilitative treatment should be joined in the global individualised project. The rehabilitation project is developed by an interdisciplinary. Hence, the clinicians have to promote an appropriate compensation process in the daily living activities with a rapid insertion of new or recovered motor-postural patterns. The model of neuromotor intervention on patients suffering from MS provides a series of important moments: (1) a specific evaluation of the motor and postural behaviour; (2) the identification of targets and consequently the treatment planning; (3) the carrying out of a therapeutic program in different kinds of management; (4) the dynamic monitoring; (5) the experimentation of new therapeutic models and new rehabilitative hypothesis; (6) the placing of a neuro-psycho-motor treatment in a global therapeutic project. Recently we have investigated the performances and the efficiency of a particular therapeutic manoeuvre for the evocation of absent motor components in an experimental group of patients with paretic-atactic features and we have studied the correlations with the results observed in a control group of patients with similar pictures, treated with stretching exercises: the study is described and the first results are reported. Furthermore we have studied the therapeutical use of a stabilometric platform, 'BIOGP', on patients with ataxia. The platform is described and the first clinical experience is reported with the protocol of evaluation. *Journal of NeuroVirology* (2000) **6,** S179–S185.

Keywords: ataxia; visual feedback; stabilometric platform; ECMA

Introduction

The process of recovery has to be considered such as a joined function of the person and the environment features in time: this is particularly clear in MS, a disease characterised by the element of time.

So, in rehabilitation you have to pay attention also to the rapidity of insertion in new or recovered motor-postural patterns and appropriate compensation processes in the daily living activities (Gasco, 1988).

Regarding new rehabilitation experiences in MS, recently we have investigated the performances and the efficiency of a particular therapeutic training. We share the study in two sections: in the first we used a method for the evocation of absent motor components, in the second we use a stabilometric platform.

Methods are, in any case, interacting forms of analysis and treatment: they can be used simultaneously or at different times on the same patient and this has to be decided by monitoring the progress of the disease in terms of an interdisciplinary view (Rossiter and Thompson, 1995).

*Correspondence: R Cardini

FIRST SECTION: Application of therapeutical manoeuvre of muscle passive shortening with traction stress on patients suffering from MS

Introduction

The study is based on the application of these manoeuvres, elaborated in Italy by Dr Grimaldi's Team (Grimaldi *et al*, 1986), in an experimental group of patients with paretic–atactic pictures.

The manoeuvre of muscle passive shortening with traction stress originates from theories of motor control elaborated by Feldman, Latash, Kelso, Turvey, Tuller and others (Feldmann, 1986; Kelso and Tuller, 1984; Latash, 1993); in particular it refers to the lambda model as key element in the organisation of motor patterns; in other words, λ is the only variable that the C.N.S. has to control.

The manoeuvre gets into the system as a disturbing element which introduces a reorganisation through the elaboration of new lambda thresholds, in order to guarantee equilibrium between inner and outside forces: this means that the C.N.S. has to prepare a greater number of length\tension curves, that is to improve the performances of muscular group target (Winters and Woo, 1990).

The aim of the study is to verify the efficiency of the specific manoeuvre compared with stretching exercises, in particular to modify the range of motion, the isometric force and the fatigability.

Results and Discussion

The graphs reported in Figures 1 and 2 show the variations of parameter X at the beginning of the study, at the end of the three sessions and at the follow-up.

The statistic test (*t*-test) (Myers and Wells, 1991) shows that the differences between the two groups are significant, with a P value < 0.05.

The graph reported in Figure 3 shows that the experimental group has modified the Abduction angle from 23 to 40°, with a medium gain of 164 per cent after 1 month, whereas the control group doesn't show any significant angle variation.

The graph reported in Figure 4 shows an improvement in the ability to hold the limb lifted, but the final values remain far from physiological ones.

The graph reported in Figure 5 shows the difference between the first and the last evaluation for the parameter Z: the bigger the difference, the bigger the impairment.

The data show a moderate increase of fatigue in the experimental group compared to the control group, but this is to be read in relation to the greater angles of abduction in the performances achieved by the experimental group.

Materials and Methods

We selected 30 patients suffering from MS with paretic −atactic pictures: all the subjects had a Hip Abductors Hyposthenia: 15 were inserted by random processing in the experimental group and 15 in the control group (Ravenborg *et al*, 1997).

No pharmacological therapy was given during the 30 days before the beginning of the protocol and during the protocol.

We did not accept patients who had muscles retraction such as to obstruct the passive hip abduction under an angle 40 degrees.

We did not accept patients who were not able to move the limb from the plane or who were unable to perform all the range of motion.

We did not accept patients who were treated at the same time with other therapeutical methods.

Evaluation test In every session, before and after the application of the exercise, we collected data of hip abduction, recorded with the patient lying on one side and with the pelvis fixed by a specific instrument (Figure 6).

We registered maximum range of motion (concentric force) against gravity (test X), isometric force (test Y) and fatigue (Test Z) (Pinelli, 1988). The patient was asked for three types of test: X=the patient has to lift the lower limb as high as he can, five times with a pause of 10 s after each lifting; Y=the patient has to lift the limb in abduction and hold it as long as possible; and Z=the patient has to lift the limb seven times in sequence. In test X the range of motion is measured in angle degrees and starts from 0° physiological angle. In test Y the time taken to decrease the initial angle to below 15 degrees is measured in seconds. In test Z, the difference in angle degrees between the first and the last performance is calculated.

Treatment Patients of the control group underwent three rehabilitative stretching sessions, lasting about 20 min: the program required hip adductors stretching with the patient in supine posture, according to B Anderson's technique.

Patients of the experimental group also underwent three rehabilitative sessions, lasting about 20 min: the patient is supine with the lower limb bound by a stiff rod, that is moved towards abduction by using an air compressed piston (connected to the limb through a stiff cable). The compressed air motor produces fast accelerations towards abductors shortening so as to exhaust all the range of motion by four to five steps (Figure 7).

Another force is applied in the opposite direction on the same limb by a spring's system, that pulls the segment towards the beginning point with an increasing traction intensity.

During the therapeutical application the exercise is repeated with some variations concerning the resistive forces, the velocity changes, the accelerations and the stop frequencies.

The two groups of patients underwent specific evaluations before and after every therapeutical session, and a follow-up 1 week after the previous session. The experimental group only had another follow-up after 2 weeks.

SECOND SECTION: Experimentation with the Kystler stabilometric platform

Introduction

We are developing a project that requires the use of a Kystler piezoelectric platform connected to a PC, in order to discover new strategies in the rehabilitation of the balance disorders (Alpini and Cesarani, 1999) and a new method to assess the voluntary control in the body shift (Barnes, 1993).

Results and discussion

We have verified a correlation between A.B.T. and BioGP instrumental test using the Pearson's correlation coefficient about 0.4 and 0.7 (Table 1). Another aim of this instrumental evaluation is to find out some indicators which inform us

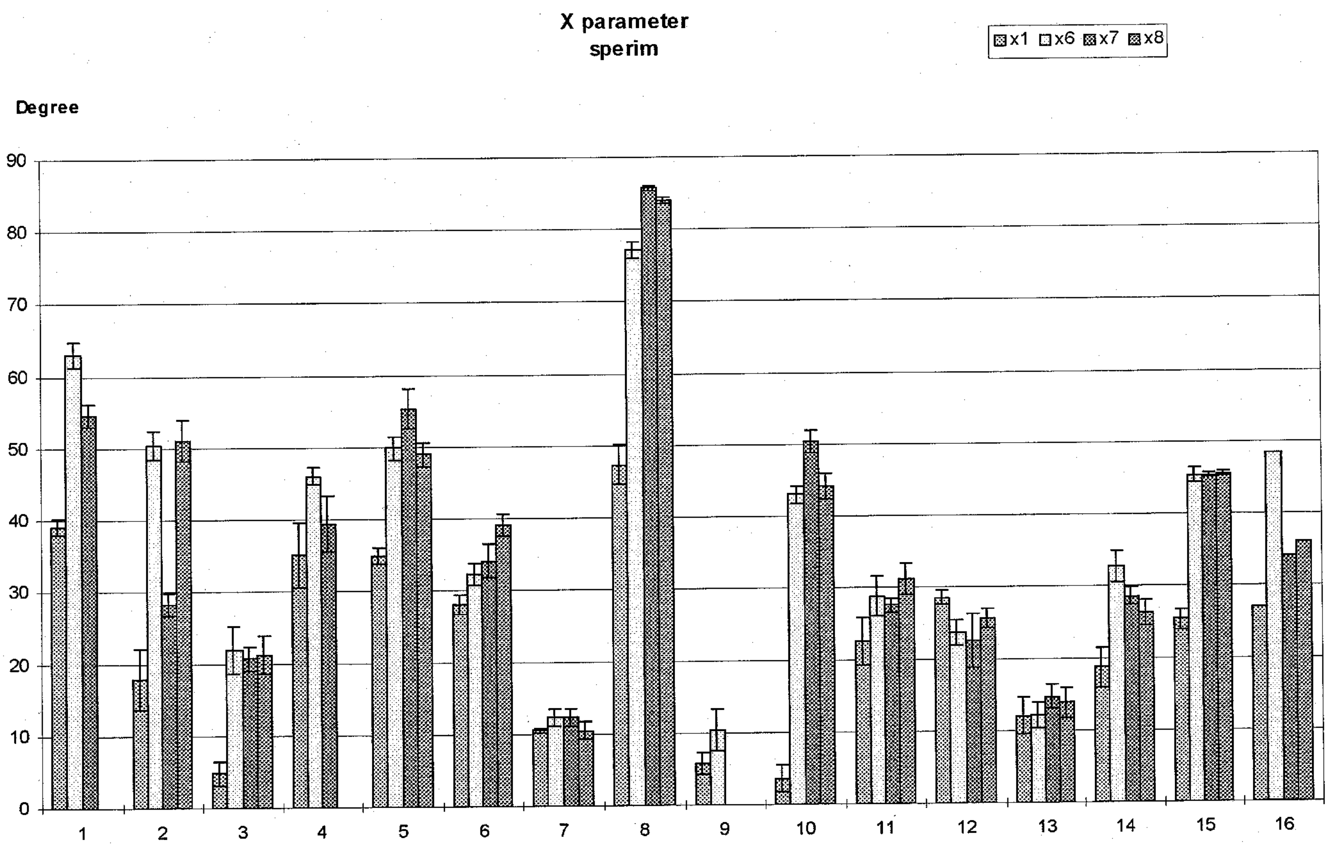

Figure 1 Parameter X in experimental group, X1, X6 post, X7 1° follow up, X8 2° follow up.

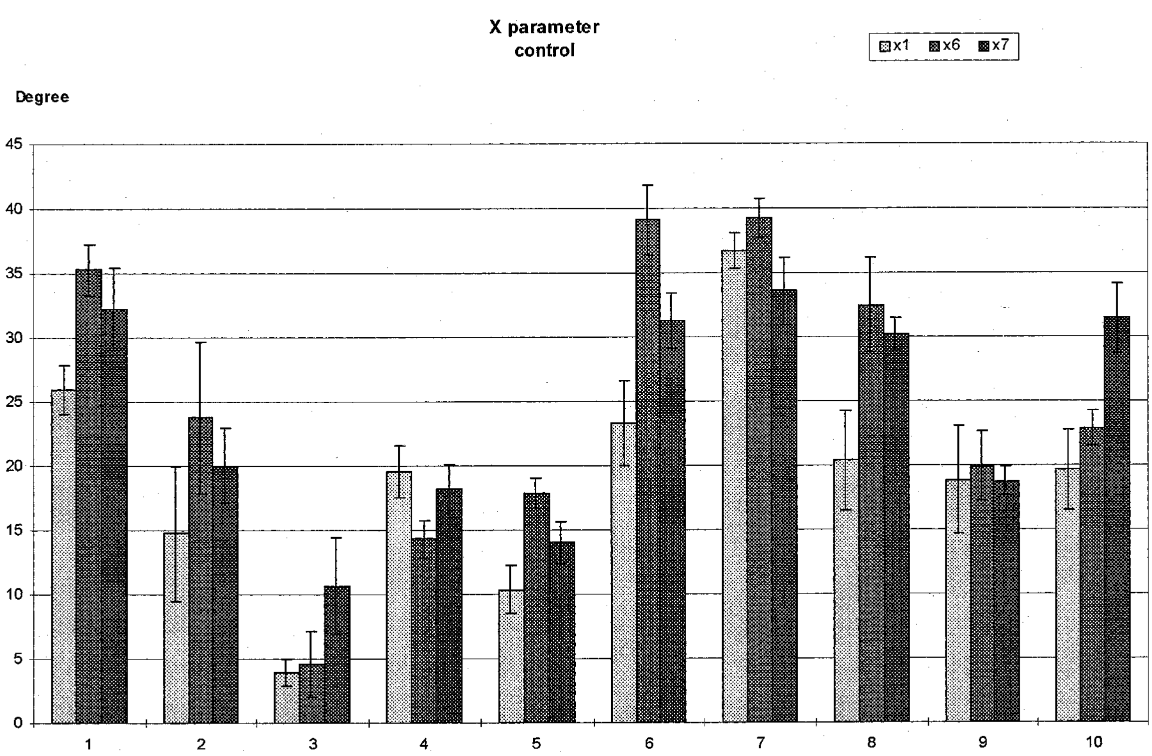

Figure 2 Parameter X in control group, X1 pre, X6 post, X7 1° follow up.

about the strategies used by patients to move the COP along defined paths on the screen : the knowledge of the patient's strategies may allow us to better understand his balance problems and to plan a specific rehabilitation program (Winter, 1995).

The results obtained so far are very interesting, both for the assessment and for the treatment of balance troubles. The system could be developed further by using different kinds of feedback signals, or by simulating dynamic situations, for example the beginning of the swing in the gait cycle.

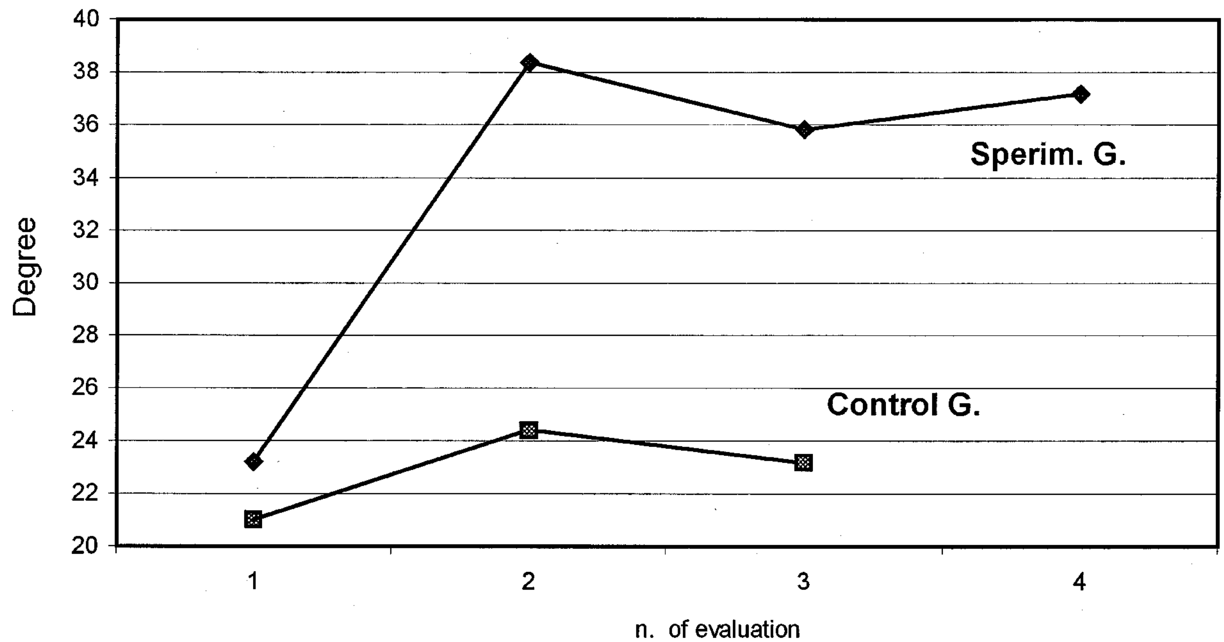

Figure 3 X parameter in experimental and control group. 1 pre test, 2 post test, 3 1° follow up, 4 2° follow up.

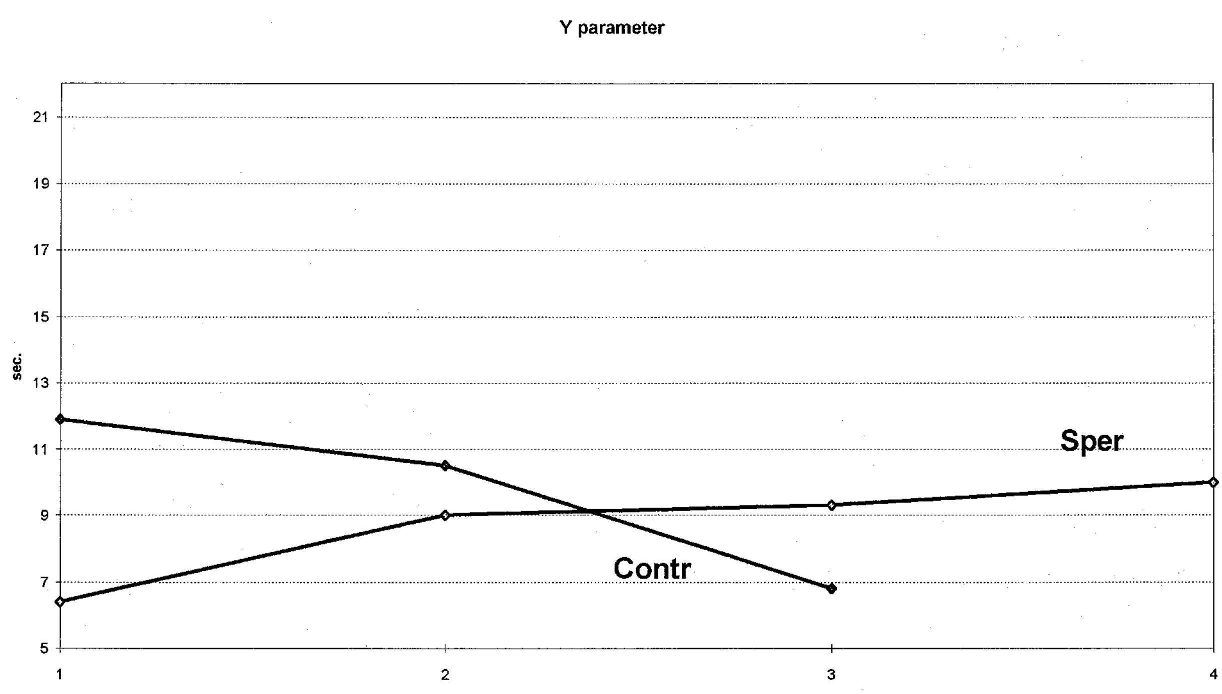

Figure 4 Y parameter in experimental and control group, 1, pre test, 2, post test, 3 1° follow up, 4 2° follow up.

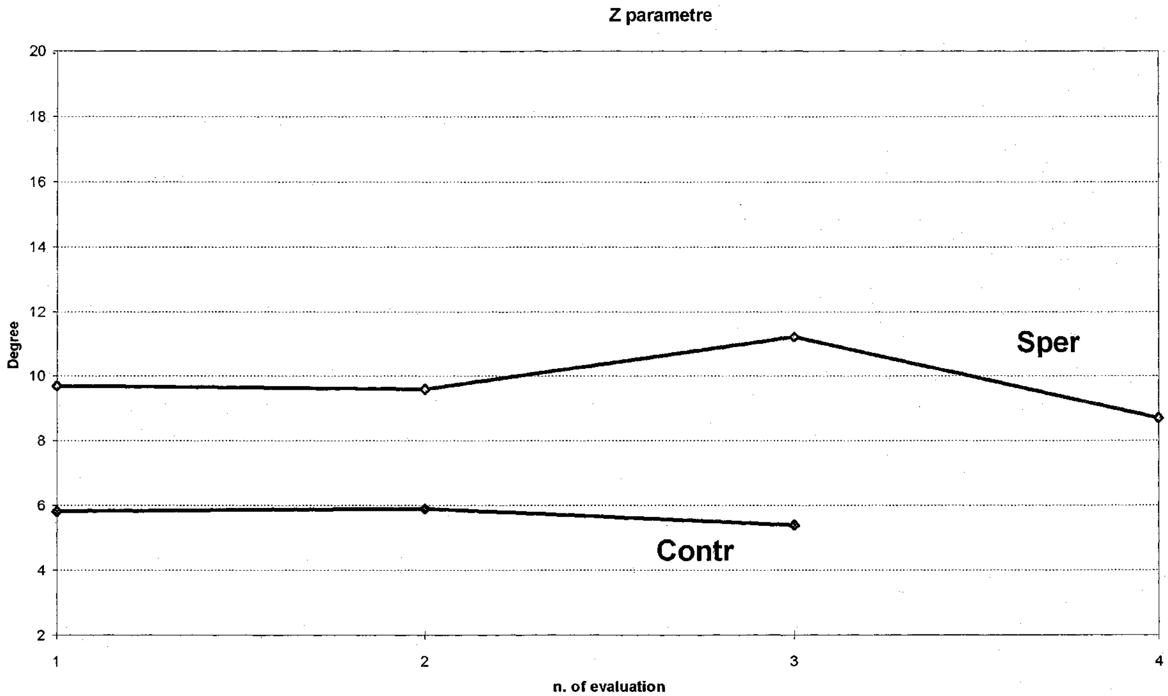

Figure 5 Z parameter in experimental and control group. 1 pre test, 2 post test, 3 1 ° follow up, 4 2° follow up.

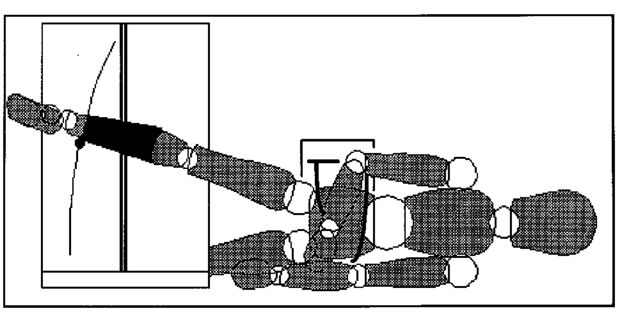

Figure 6 Evaluation instrument: the patient is lying on one side with the pelvis fixed.

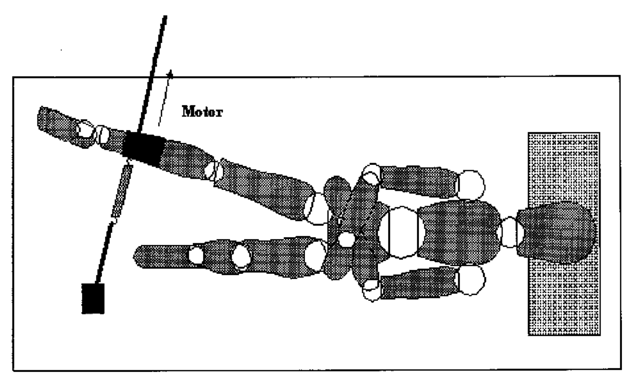

Figure 7 Therapeutic manoeuvre: the patient is supine with lower limb bound by a stiff rod that is moved towards abduction by usiing an air compressed piston.

Materials and methods

We evaluated 35 patients suffering from MS, a sample recruited at random from a larger group of patients with Ataxia (Boccardi, 1988), and 23 healthy subjects. The patients had both a middle–light balance trouble and a hyposthenia of the lower limbs. The computerized system (called BioGP, Figure 8) detects the shift of the centre of pressure (COP). The COP is shifted by voluntary movements of the subject who follows a path displayed on the screen.

BioGP system consists of a force platform (Kystler 918 1 B), an amplifier, an A\D converter and a PC (Guidetti, 1989): the signals from the A\D converter are processed in order to display the patient's COP on the screen (Figure 9). The system allows us to change the gain of the visual feed back.

Concerning the possibility of a specific evaluation, we used a partial score from the Ataxia Battery Test (Fregly, 1966) and compared these scores with the laboratory data from BioGP. The Ataxia Battery Test assesses the subject's performances with nine items: we have chosen only the items which refer to the static abilities.

The trial consists in two different parts, vertical and horizontal. We invite the patient to place the cursor in the rectangular zone (Figure 9): the trial starts here and the patient has to follow the path and come back to the rectangular zone. For the assessment protocol the patient has to repeat every

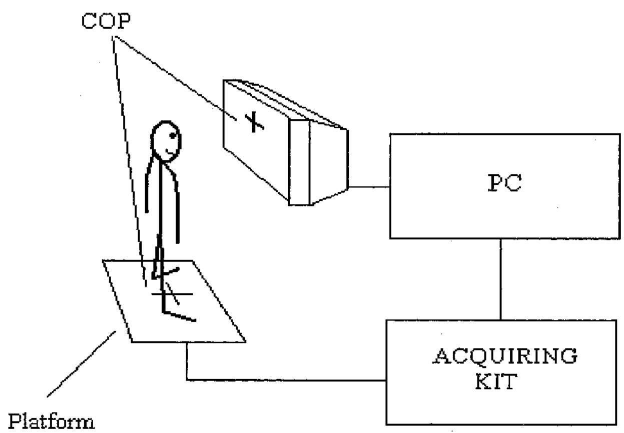

Figure 8 The computerised system BioGP detects the shift of the centre of pressure.

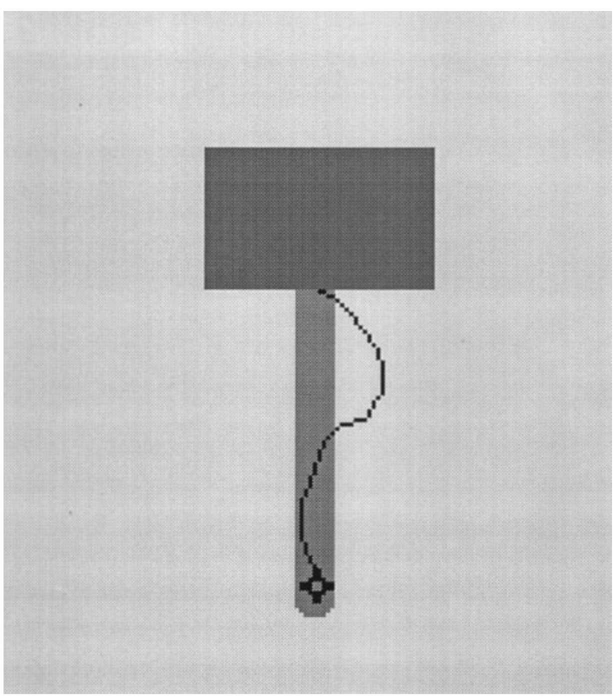

Figure 9 Path followed by the patient with the COP position feedback on the PC screen.

path four times. A series of parameters are found, and they are used to describe the patient's performance : the 11 main parameters can show the different strategies of pursuit and the features of the spatial autocorrection. The most important are:

- LR=the ratio between the trace outside the path and the total trace length
- lr=the ratio between total trace length and path length
- Speed=average speed in cm/s
- Pos=the mean position with respect to the axis of the path
- Sway=the standard deviation calculated as percentage of the path
- End=represents the distance between the maximum COP trace's shifting and the end of the path
- Direction changes=the ratio between the number of direction changes, going and returning, and the path length.

In the trial the patient is standing without shoes in front of the screen: the distance between him and the screen is 1 m; after a short time, the patient begins to perform the tracings shifting his own barycentre.

Discussion

The model of neuromotor intervention on the patients suffering from MS provides therefore a series of important moments, that are closely linked:

1 A specific evaluation of the motor and postural behaviour of the patient (Kelly, 1985), which is carried out through the instruments of modern physiatry (Wade, 1995; Crenna *et al*, 1992), the application of protocols and the use of specific technologies (such as neurophysiological and biomechanical investigation).
2 The identification of the targets and consequently the treatment planning that can work at different levels:

- by re-balancing the kinesiological compensations;
- by taking advantage of the residual potentialities;

Table 1 Correlation coefficients

	Path	*RL*	*Speed*	*Middle A*	*Sway A*	*Middle R*	*Sway R*	*↓Mtime*	*Time*
Pearson	V1	−0.35	−0.38	−0.29	−0.38	−0.39	−0.24	−0.17	−0.01
Pearson	V1	−0.72	−0.56	−0.46	−0.67	−0.38	−0.61	−0.50	−0.69
Pearson	HOR	−0.53	−0.54	−0.57	−0.40	−0.1	−0.40	0.01	−0.08

RL: Ratio between the trace outside the path and the total length, Speed: Average speed, Middle: Average position on the path (A: COP moves backwards or on the right in the horizontal path, R: COP moves forward or on the left on the horizontal path), Sway: The patient's sway on the path, ↓MTime: Ratio between the time spent outside the left (upper) side of the path and the number of exits, Time: Average time spent outside the end of the path.

- by reducing the energetic costs under the same functional performances;
- by preventing injuries to muscles, skeleton, tendons, ligaments, respiratory and vascular systems and to the psyco-motor components;
- by changing the strategies of movement;
- by using specific orthosis, splints and aids.

3 The carrying out of a therapeutic programme in different kinds of management. For this purpose the pursuit of a different relation among territory, hospital and the patient's house is very important.
4 The dynamic monitoring, which has to be performed by rehabilitation experts in collaboration with other specialists and psychological and social operators, by a series of follow-ups and a periodic re-formulation of the targets of the treatment.
5 The experimentation of new therapeutic models and new hypotheses in rehabilitation.
6 The placing of a neuro-psycho-motor treatment (which considers all the aspects of movement, also the emotional-communicative ones) in a global therapeutic project, which has to be managed in an interdisciplinary way. This is particularly important concerning patients suffering from MS, because of the temporal evolution of this pathology, the symptomatological polymorphism and the possibility of more functional systems being involved at the same moment. Therefore specialists and operators are who are rapid in performing the analysis, reaching the right therapeutic decisions, and who are able to co-operate.

The therapies highlighted in these studies summarise several points mentioned above because of their rapidity and ability to focus on specific problems.

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