Analysis of Gait in a Patient Affected by Parkinson's Disease: Rehabilitative Implications

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4.10.1 Medical History

The patient N.M., 64 years of age, has been affected by Parkinson's disease for about ten years.

During recent years, he has shown visual evidence of marked and disabling motor fluctuations, postural and gait disorders, and balance disorders with frequent falls. Because of the failed response of oral therapy, the patient was subjected to a percutaneous endoscopic gastronomy (PEG) implant for duodenal infusion of Levodopa.

The surgery reported an improvement in motor compensation, with noticeable reduction in the fluctuations during the course of the day. Nonetheless, the postural disturbances persist, in particular the anterior flexion of the trunk and the gait disorders, although to a markedly decreased degree in comparison with pre-implant evaluations.

He is hospitalized at the Department for Movement Disorders at the IRCSS (Scientific Institute for Research, Hospitalization and Health Care) Centro Neurolesi "Bonino Pulejo" di Messina to carry out intensive rehabilitation, and for the development of a rehabilitative program, to be carried out at home, once discharged.

4.10.2 Definition of Rehabilitation Project

Synthesis of current situation:

- Patient alert and cooperative, oriented in time and in space.
- Camptocormic attitude with anterior shift of the head, moderate facial hypomimia, walking with small steps, with reduced pendular quality of the upper limbs. We notice a limited elevation of the right shoulder, the location of previous dislocations and subsequent relapses.
- Generalized bradykinesia in four limbs: the patient carried out the postural passages with adaptations.
- The Barthel Index Score reported is 60/100.

Short-term goals:

- Stability in internal medicine, maintenance of sensory-motor functions, the ergonomization of the muscular reserves with increase in residual muscular force with respect to the aerobic threshold of fatigue, improvement in the postural passages, selective work of reinforcement of the intra and extra rotator muscles of the right shoulder.

Medium-term goals:

- Stabilization of the trunk with gait training exercises in feedback and feed-forward in upright or seated position.

Long-term goals:

- Maintenance of autonomy achieved and re-integration into the family and social environment.

The patient was trained to perform gait training with the Biodex Gait Trainer 3 during his stay. The duration of the training was one month, with tri-weekly frequency, of a duration of 20 minutes for each session.

This was added to rehabilitative treatment, consisting of two hours of physical therapy per day, one in the morning, and one in the afternoon, respectively.

4.10.3. Training

On the initial evaluation, N.M. carried out the counting of steps achieved in 15 seconds down a corridor. About 28 steps were detected, corresponding to a frequency of 112 (28 x 4) spm.

From a qualitative point of view, a rather reduced step-length resulted, as well as a *noticeable reduction in the pendular synkinesis*.

The scales used for the initial evaluation were:

- Falls-Efficacy Scale-International
- 10 meter Walk Test
- Timed Up & Go Test
- BERG Balance Scale

4.10.4. Means of Performing the Training

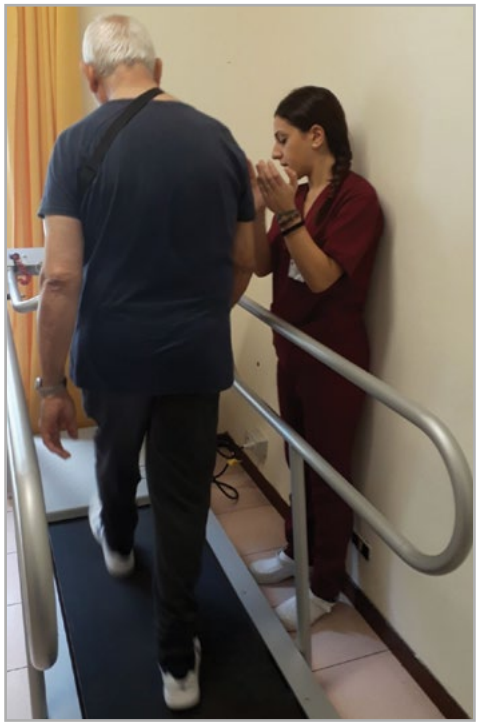
In every session carried out, it was possible to detect the relative results at different parameters:

- Total Time: duration of each session, equal to 20 minutes
- Total Distance and Steps
- Average Step-Length
- Step-Length Variability
- Average Walking Speed
- Time on Each Foot

Figure 4.10-1 Training shown with Biodex Gait Trainer 3 and Music-Assisted Therapy Package.

The first parameters that we worked were those relating to the entrainment and the timing of gait, focusing on reaching and synchronizing with the imposed rhythm. The first sessions were in fact carried out using songs between 105 and 110 bpm in order to have the patient maintain an external rhythm very close to his own. With the progression of sessions, once entrainment has been achieved, we tried to work more specifically on the spatial and temporal parameters of gait, focusing on increasing step length and decreasing walking speed, as well as on decreasing steps in relation to distance traveled.

During each session, the patient was guided on the maintenance of rhythms and on the performance of single, indispensable movements in the cycle of a step. Through the clapping of hands, the snapping of fingers, and input by the physical therapist, together with feedback in real time provided by the [Biodex Gait Trainer 3] display on the device, it was possible for the patient to reach and maintain rhythm during each session.



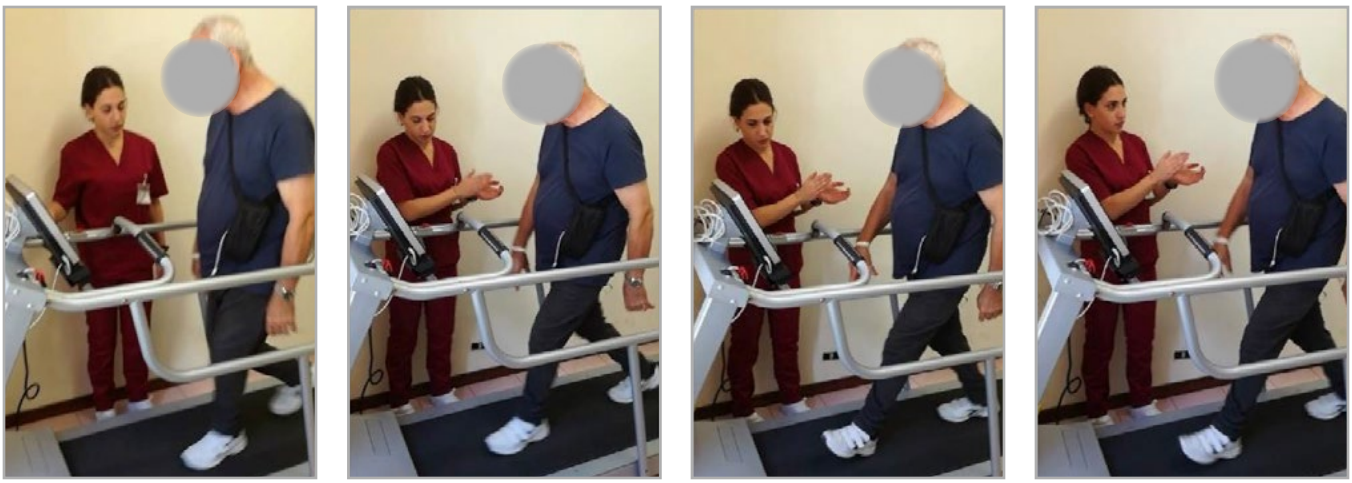
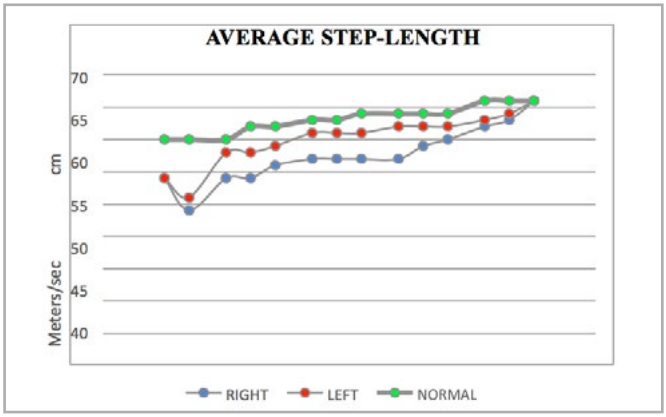


Figure 4.10-3 Increase in step length; progressive increase in pendular synkenesis.

4.10.5 Results of Training

In the various sessions, improvements were achieved in the different parameters, the most significant of which are reported in the graph below (Reports No 1, No. 2 and No. 3), or the Step-Length, principal objective at the time of training, and the Walking Speed; the percentage of support of each foot (% Time on each foot) has brought more even distribution with the progression of training, reaching normative values at the last sessions.

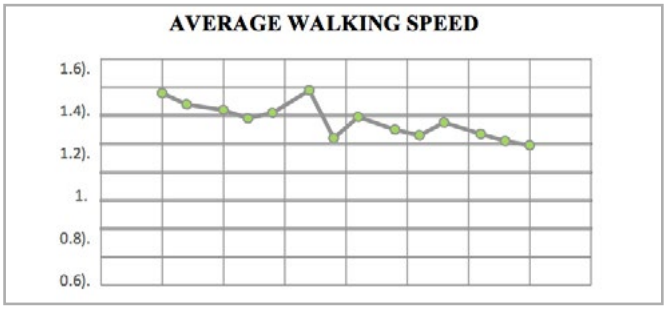


Report n.1 Average step-length.

4.10.6. Post-Training Evaluation

At the end of each session, the final evaluation took account of the amount of steps performed in 15 seconds, in which, gradually, it was possible to observe, other than a slight increase in number, a greater pendular quality of the limbs, a more equitable distribution of the single phases of the cycle of steps between left and right.

At the end of training, after 15 sessions, the patient was again evaluated according to the evaluations performed at the beginning of treatment, whose scores are reported below, compared with those relating to the initial evaluation.



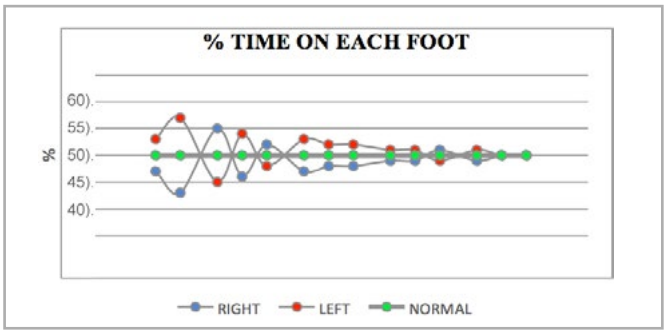
Report n.2 Average walking speed.

Falls Efficacy Scale-International:
initial score: 29/64; final score: 34/64

10 meter Walk Test:
initial score: 4.19 sec; final score: 3.9 sec

Timed Up & Go Test:
initial score: Sx) 8,04 sec – Dx) 7,35 sec
final score: Sx) 7,40 sec – Dx) 7, 15 sec

BERG Balance Scale:
initial score: 50; final Score: 52



Report n.3 Percent Time on Each Foot.

4.10.7. Considerations and Conclusions

The training, accompanied with traditional treatment, has enabled the achievement of performances that have less motor clumsiness at each session, as reported by the patient, which are not limited to the duration of treatment but lasting even in subsequent hours.

Thanks to the extreme precision of the information provided by the system [Biodex Gait Trainer 3], it was possible to work selectively on different parameters, obtaining overall results that would include the full mobility of the patient in the performance of all daily activities, in addition to, as the scores obtained in the final evaluation demonstrate, performances concerning balance and general motor ability.

The role of the physical therapist was fundamental, not only because of his understanding of the device, but also for consideration of all the individual variables of the patient, and especially, in the various facets and peculiarity of the disease from a motor and non-motor point of view.

Furthermore, the physical therapist was important in the scheduling and execution of treatment, since it is necessary, during the performance of each session, to correct the incorrect postural attitudes and to favor the achievement of those functional for motion, to encourage the patient to follow the rhythm, sometimes reinforcing the sounds emitted by the machine, supporting and encouraging him while he is carrying out a good implementation or guiding him in the improvement of some aspects of movement.

With these thoughts in mind, we can affirm that any treatment, although extremely precise in terms of standardization and comparability, can only be put in place by an attentive operator, who knows the functioning of the devices and their use, who considers the aspects on which you can act, and the limits imposed by the disease, which do not permit its application.

And finally, the role of the physical therapist is of fundamental importance as a figure who knows how to create a favorable and stimulating therapeutic relationship with the patient at every moment. There are no perfect human minds or perfect machines: only both working together make it possible for rehabilitation to grow slowly, creating the basis for the achievement of goals, in addition to those anticipated and hoped for, rationalized in relation to the use of resources and aimed at the efficiency of treatment.

Conclusion

The rehabilitative approach to gait disorders in PD is a field in continual growth, considering the large number of studies in progress. Although there are not yet universally shared and applicable guidelines in a strict sense, the use of different manner of cues, combined with traditional treatment, significantly improves the different parameters of Parkinson gait.

The importance of this application certainly resides in the possibility of providing alternative movement patterns capable of bypassing present deficits, by the strengthening of preexisting loops, which offset the difficulties in the generation of internal rhythm.

Thanks to the consideration of all these issues in rehabilitation--represented by the reduction in motor learning and the mechanisms of neuroplasticity, as well as by marked difficulty in the management of the timing of sequential motor actions--it was possible to reach levels of improvement, through the application of techniques that promote the sensory integration provided by cues and the use of methods aimed at stimulating attention levels, motivation, and involvement of the patients during the training sessions.

To the limits represented by the absence of guidelines for treatment, the contribution of state-of-the-art devices has surely provided support that is not insignificant.

Their use has in fact assumed great importance from a point of view of research, allowing for the achievement of standardized results, which are comparable in large samples of patients. Their application furthermore represents an exclusive method of integration of different cues, improving attention, motivation and the involvement of the patients.

Paired with traditional treatment, the various devices improve the mechanisms of motor learning and, using repetition, provide a large amount of support in consolidation of motor memories which is not limited to the duration of training. Their capacity of providing alternative patterns that the patients “use” to bypass their own deficits constitutes great input in establishing compensation models, the basis of neuroplasticity.

It should be stressed that the devices must be used by expert operators who are adequately trained in the devices' function, especially in their means of application and possible outcomes in different pathologies, as well as in understanding when the limits of the disease do not permit their use.

Although a standardized treatment is in fact capable of obtaining extremely accurate and precise results, the rehabilitation field must always keep in mind and never overlook the individuality of the patient, considering the psychological and emotional variables, which also constitute the various facets and peculiarities of the disease, and are as important as the motor ones.

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