

# Advances in Clinical and Medical Research

Genesis-ACMR-5(2)-79  
Volume 5 | Issue 2  
Open Access  
ISSN: 2583-2778

## Neuromotor and Occupational Rehabilitation Therapy in Parkinson's Disease

**Mandalà Giorgio<sup>1\*</sup>, La Mantia Valentina<sup>1</sup>, Passantino Giuseppina<sup>1</sup>, Terrasi Micol<sup>1</sup>, Sofia Mandalà<sup>1</sup> and Pietro Cataldo<sup>2</sup>**

<sup>1</sup>UOC Rehabilitation Medicine, Buccheri La Ferla Fatebenefratelli Hospital, Palermo, Italy

<sup>2</sup>Department of Psychology, Educational Science and Human Movement, University of Palermo, Italy

\***Corresponding author:** Mandalà Giorgio, UOC Rehabilitation Medicine, Buccheri La Ferla Fatebenefratelli Hospital, Palermo, Italy.

**Citation:** Giorgio M, Valentina LM, Giuseppina P, Micol T, Mandalà S, et al. (2024) Neuromotor and Occupational Rehabilitation Therapy in Parkinson's Disease. *Adv Clin Med Res.* 5(2):1-4.

**Received:** December 28, 2023 | **Published:** March 1, 2024

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### Abstract

Parkinson's disease involves a gradual and progressive loss of motor, communication, swallowing and cognitive functions with a variable rate and speed of progression. Rehabilitation therapy has proven effective in maintaining functions and autonomy for longer and in some cases also in improving these skills. Given the impairment and slowing down of numerous functions of the central nervous system, rehabilitation must be a process integrated by multi-professionalism and interdisciplinary within an individual rehabilitation project.

Neuromotor and occupational rehabilitation are planned for motor and ADL autonomy, speech therapy rehabilitation for verbal communication skills and swallowing, neuropsychological rehabilitation for higher cortical functions and cognitive decline. Social and work rehabilitation will also be necessary to facilitate reintegration.

**Case-Report** | Giorgio M, et al. *Adv Clin Med Res* 2024, 5(2)-79.

**DOI:** [https://doi.org/10.52793/ACMR.2024.5\(2\)-79](https://doi.org/10.52793/ACMR.2024.5(2)-79)

## Introduction

Neuromotor Rehabilitation and Occupational Therapy: It's used for recovery of motor skills that are deficient or lost due to illness and disuse, but also stabilization of basic skills for maintaining autonomy in Activities of daily living. Speech therapy rehabilitation: It's used for recovery of communication skills, dysarthria, hypo\dysphonia and dysprosody, but also maintenance of nutritional and swallowing ability safely in bradyphagia.

Neuropsychological rehabilitation: It's used for treatment of brain psychism and executive function disorders due to deafferentation of the frontal lobes, but also increase in cognitive reserve for the reduction of the functional incidence of cognitive disability at the onset of the first dementia-related signs. Social and work rehabilitation. Used for Family and work reintegration, psychological support for the patient and family, commitment to socialization activities.

## Literature Review

Cl Tomlinson's meta-analysis<sup>1</sup> collects numerous studies demonstrating the effectiveness of physiotherapy in slowing the progression of disability in PD. The type of motor treatment used is not indicated or comprehensively described in the studies. But the effectiveness of "Motor Therapy" is still demonstrated with strong evidence in the initial, advanced and evolved stages. In particular, evidence of effectiveness after rehabilitation is demonstrated in 9 outcome tests:

- Increased walking speed,
- Increase in distance traveled in the 2\6 M.w.t.
- Improvement of the freezing score in the G.Q.
- No improvement in cadence
- Reduction of time in the up & go test
- Increased breadth in the functional reach test
- Increased score on the Berg balance scale
- Reduction of falls (as an absolute value and in the individual patient)
- Increase in motor score and ADL s.s. UPDRS

GM Petzinger<sup>2</sup> says that it was not possible to demonstrate the greater or lesser effectiveness of a type of treatment given the heterogeneity of the studies that evaluated interventions of:

- Non-specific physiotherapy
- Exercises for the limbs
- Treadmill training
- Sensory cueing interventions
- Dance
- Martial arts

The short follow-up of the analyzed studies of 3-6 months should be noted. A. Amara<sup>3</sup>, demonstrates that neuromotor rehabilitation and the improvement of Physical performance also has favorable effects on non-motor symptoms and in particular autonomic dysfunctions, sleep disorders and cognitive decline.

## Methods

**Restorative Rehabilitation:** Is useful in the initial stages of the disease, approximately the first 8 years from diagnosis, until cognitive abilities transform and decline into parkinson\dementia. **Substitutive Rehabilitation:** Is necessary in the advanced and advanced stages of the disease when one must be satisfied with maintaining basic and vital skills with a satisfactory perceived quality of life.

In the Restorative Rehabilitation: Overcome rehabilitation of the musculoskeletal motor periphery, except for the treatment of hypokinesia and rigidity. Maintaining a good general performance in the gym, respecting the previous level of physical activity.

Transposition of discoveries in the field of neuroscience. Possibility of recovering lost motor skills through their new learning. Treatment techniques that exploit the discovery of the motor image (motor imagery in the premotor areas of the frontal lobe as the start of neurobiological activation of the action (the brain knows the action, not the single movement) and use the re-enactment of the movement and action) and mirror neurons (action observation). Treatment techniques such as mirror therapies which exploit mirrors with different assumptions than the previous ones.

Treatment techniques that exploit the plastic possibilities of sensorimotor learning of the CNS. Recent discoveries on the mechanisms of comparison that generate and regulate learning (Dendre); and the importance of perceptual associations in motor learning (Synesthesia).

## Neurocognitive rehabilitation

It exploits the Comparison of Actions (C.T.A.) and perceptual association, as a strategy for motor recovery through learning. With the exercises, perceptive hypotheses are proposed that allow us to grasp the similarities and differences between the current performance and the previous perceptual memory of the normal performance for the purposes of new learning.

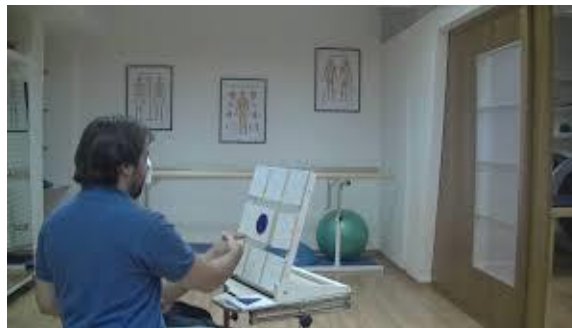
The C.T.A. it is necessary to relearn the adequate performance of current performances, no longer functional to achieving the aim of the action. Comparing the perceptions deriving from the pathological performance with the perceptual memory (Kinesthetic, tactile, Proprioceptive), of past and significant experiences and actions. The hands lose information and motor capacity. Perception is crucial for movement and vice versa.

## Examples of Neurocognitive Rehabilitation Exercises



Contour recognition

## Comparison exercises on the board



Compression sponges of different consistency

The perceptive hypothesis created with the help of the physiotherapist thanks to the multisensory integration of tactile, proprioceptive and kinesthetic information, with the exclusion of sight, must be verified at the end of the exercise and compared in terms of similarities and differences to generate a new motor learning.

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Fragmentation for the hand and wrist



Exercise for precise end-to-end digital gripping, with the recognition and comparison between rulers of different heights.

### Finger weighting exercises and heel approach to the ground



Exercises with a bow for the extension of the wrist to reach and prepare for the hand grip, and exercises with a front spring box and a rear sponge, for the transfer of load from the heel to the forefoot during the rolling phase of the step.

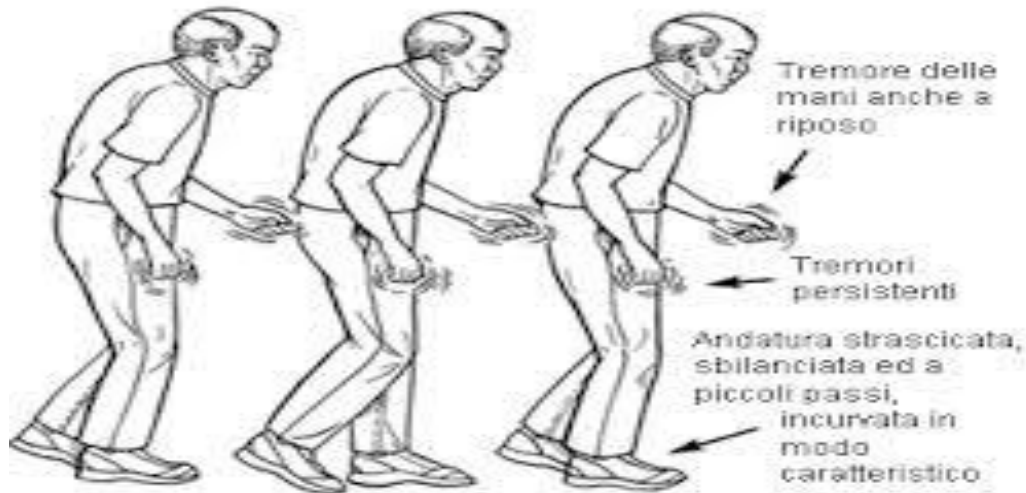


With Rehabilitation we have the possibility of learning a new system of relationships, to perform adequately to carry out the task in different ways, exploiting the compensation of less compromised systems or less rigid articulations; despite the pathological manifestations progressing on the motor, linguistic and cognitive aspects, involving basic functions. The use of visual, auditory or multisensory cues replaces the perceptual/motor deficit by generating an information flow that allows for improved performance.

Walking aids (canes, walkers, braces for the lower limbs) can allow the maintenance of autonomy in walking, guaranteeing load support, stabilization of balance and postural control, support for hyposthenic or hypotonic muscles. The aids for postural transitions and transfers (caprie, sick lifts, standing, postural corsets, wheelchairs or other supports for the trunk and the sitting position), can allow the maintenance of complete or partial autonomy in transfers, guaranteeing safety also for subjects in which the serious postural alteration, balance and loss of control of the trunk do not allow the maintenance of orthostatism.

### **Special attention to the trunk and its information function**

Based on the processing of information coming from the relationships of the different parts of the body and the trunk (symmetry and verticality) the CNS organizes and controls the motor strategies that allow man to maintain a position and to move and orient parts of the body in function to example of the socket or the cammino.



Therefore, on the basis of this systemic vision of the trunk and the analysis of thirty-year studies, both on the midline (Manzoni 1989) and on the spatial coordinates of the body image and extracorporeal space (Grusser 1983), it can be deduced that the organization trunk motor skills play a fundamental role in measuring the space of action.

### Alterations in the Functions of the Trunk In PD

In the parkinsonian patient, the motility of the trunk and its contribution to the performance of spatial operations is always altered and reduced. Its motility presents alterations that affect:

- The support surface: both in terms of its perimeter and its organization.
- Both in a sitting and standing position. It is disorganized, and in some cases with a concentration of the load in a single sector.
- The characteristics of the surface and the arrangement of the load are non-specific and stereotyped.
- They do not undergo modifications or in relation to a change of conformation, nor in relation to a different orientation of the body or part of it in space.

Compensatory oscillations of the trunk in space are also highlighted.

- These are significant of an inability to transfer the load within the base of support in relation to modifications of the upper limbs in space required by the action.
- The ability to organize the transfer of load from the pelvis to the feet.
- The function of connecting the trunk to both lower limbs through the pelvis in relation to the correct organization of the midline.

Also affects Perception, the integration of information from multiple systems, the verticality function, the support function, the extension function, the dynamic control of the organization of the support base depending on the task, the Balancing activities and the ability to vary the organization of the support base.

Based on observation, the patient presents: Forward shift of the center of gravity; Tendency towards anteroflexion of the head and trunk which appears kyphotic; Flexion of the elbow and knee joints;

Slowness in starting and stopping the gear with a serious tendency towards anteropulsion in the starting phase and retropulsion in the stopping phase; The phenomenon of "freezing" is generally described by patients themselves as "the feeling of having your feet glued to the ground".

The loss of the commute of the upper limbs during walking which constitute a single block with the trunk, difficulty in coordination in the reciprocal action of contraction and relaxation of the agonist and antagonist muscles. The progressive loss of the ability to explore and orientate the upper limbs in space (as occurs for example in the act of sitting). The loss of the ability to maintain the symmetry and verticality of the trunk.

Often the execution of a movement can be interrupted, not only due to excessive concentration and strong emotional participation, but also due to the excessive perception of sensory stimulations coming from the outside (as happens for example during the passage of a door or overcoming an obstacle), due to a real "sensory traffic jam" determined by exteroceptive and emotional stimulations, which do not correspond to an adequate motor response.

As if an amplification of sensory stimuli cluttered the space of the Parkinsonian patient, who can perceive as an obstacle any object that occupies, even at a distance, the ideal trajectory that separates him from the objective to be achieved:

- Massage and joint mobilization techniques must be slow and gentle muscle strengthening is reasonable if it was in the person's previous habits.
- Shoulder exercises.
- oculomotor coordination in the execution of the current performance.
- postural reaction and right translation of the trunk.
- use of the upper limbs to maintain balance and extend the trunk.
- treadmill and individual mirror cardiorespiratory training and good maintenance of basic motor performance.

Group activities in the gym can make use of a large mirror that offers visual feedback on the result of the current performance but the images are reversed, and the right becomes left.

- Preparation of the session: the sequence of exercises and activities that will be carried out, the most difficult steps, when to stop and rest must be explained.
- The spaces must be large, the gyms must be safe places even in the event of a fall.
- Slow and coordinated activities also with musical accompaniment to give rhythm and cadence.

Other organized physical activities include feldenkrais, postural gymnastics, tai chi chuan, yoga, martial arts use of coordinated and rhythmic movements of dance and voluntary control of gestures, tango, ballroom, and other dances that constitute also a source of entertainment.

A moment of restitution is appropriate, a final quarter of an hour to focus on emotional sensations, physical perceptions and emotions, relationships. The selection of patients must be made based on motor competence, making selections on the patients concerned, for severely compromised or slightly compromised skills also considering the degree of cognitive relational impairment.



Rehabilitation of balance disorders and prevention of falls with the use of stabilometric and postural platforms also equipped with visual feedback. Individual exercises with group observers must repeat the performance seen (action observation). Video game platforms are a great pastime. they train the execution of complex movements, with virtual sound and visual feedback on the result of the performance. Robotic rehabilitation with specific applications of robotic devices addressing specific functional deficits.

Also important for relaxation and socialization are outdoor group activities, such as walks on natural terrain: optional use of trekking poles, or Nordic walking. An opportunity to exchange experiences and social activities and to recover the perception of "normality". Quality of life is the primary objective that the entire interdisciplinary team must pursue and it will never be enough!

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