Neurocognitive Rehabilitation Approach: Not only for Neurological Diseases

In his novel, *The Man Who Mistook His Wife for a Hat*, Oliver Sacks wrote that "Every act of perception, is to some degree an act of creation, and every act of memory is to some degree an act of imagination" [1]. Also, from Berthoz's point of view, perception and cognition are inherently predictive, allowing us to anticipate the consequences of current or potential actions.

Then, the brain acts as a simulator that is constantly inventing models to project onto the changing world. These models are corrected by steady minute feedback from the context. All this is possible thanks to the plasticity and adaptability of the central nervous system. Respect to this "sense of movement", we can move in the direction in which we are looking, anticipate the trajectory of a falling ball, recover when we stumble and continually update our own physical position [2].

The scientific literature indicated that exercise has positive effects on neural plasticity and in particular neurocognitive exercise [3].

The role of physical therapy is to help regain and restore the pain-free and comfortable movement and overall health that a person experienced prior to an injury, illness, or disability. To achieve this, a planned program using a holistic approach is designed.

Also, respect to orthopedic rehabilitation, physiotherapists uses manual therapies and perform stretches and traditional exercises in gradual progression to optimize the physical abilities of the patient.

Thus, we must ask whether we can also apply the principles of neurocognitive rehabilitation to orthopedic diseases and, perhaps, after orthopedic surgery.

Yet, despite the many postoperative rehabilitation modalities, a lack of a consensus regarding the duration, intensity, and delivery of the rehabilitative exercises are often missing; an evidence-based practice guideline remains absent [4].

To date, neurocognitive approaches have been used successfully in neurological [3,5,6] and, also, orthopedic diseases [7].

The Perfetti method, a type of neurocognitive rehabilitation approach, considers the therapeutic exercises for monitoring the recovery of the injured function as a "learning process in pathological conditions" [8,9].

Unlike the traditional rehabilitation approach, the neurocognitive approach is based on specific rehabilitation settings that can help the patient to extract...
meaningful information that can lead to conscious recovery.

The three principles of neurocognitive therapeutic exercises are to assume: i) rehabilitation as a learning process, ii) the body as a receptor surface, and iii) the movement as knowledge.

Each proposed exercise must be broken down and respect the “control” with regard to the movement parameters (i.e., spatiality, temporality, and intensity).

A widely chosen element in neurocognitive rehabilitation and in the Perfetti method is the use of Motor Imagery (MI), that guides the patient in the selection of information (correct perceptual modality) with respect to the perception (anticipation-perceptive hypothesis of the action). This tool allows attention to be directed constantly toward specific information.

All of these elements could be useful and applied in the recovery of orthopedic diseases, allowing to control painful conditions better [10]. A study about the proper neurocognitive knee rehabilitation after surgical reconstruction of the anterior cruciate ligament has shown that a neurocognitive rehabilitative approach is an efficacy treatment with a more rapid load symmetrization, a reduction in step width, and faster resolution of oedema [7].

In addition, other authors suggest that neurocognitive rehabilitation reduces pain and improves function in patients with shoulder impingement syndrome, with the benefits maintained even at follow-up: the program includes 1 hour per session and 3 times a week for 5 weeks of consecutive treatment [9].

In particular, neurocognitive therapeutic exercises are divided in three degrees. In the first degree, the exercise is performed with the eyes closed with the help of the therapist (manual), whereas in the second degree, the exercises are performed with the eyes open with the aid of the therapist (verbal or manual). In the third degree, they are intended to achieve modularity and optimization of the movement trajectories: exercises are executed independently by the patient under the supervision of the therapist [11,12].

In each mode of exercise, the patient as to solve a neurocognitive task, which always includes proprioception elements. For example, if the patient can carry weight on the operated or injured limb, to recover his gait pattern with respect to direction, the following exercise can be proposed: in an upright position, the patient is placed between parallel bars, with the operated lower limb placed on a scale and the healthy lower limb on an inclined plane with curvilinear trajectories. Then, the patient has to trace the various trajectories with the heel of the healthy limb, both uphill and downhill. The exercise should be performed in the third degree, programming the load on the operated limb and varying the angle of the sliding surface. This exercise should also control the load transfer between the 2 limbs and the heel approaching the ground [4]. Neurocognitive exercises can also be used together with traditional exercises in orthopedic rehabilitation in an integrated approach. Them, considering these interesting results, further studies are needed to standardize the neurocognitive rehabilitation protocols in orthopedic diseases.

**Conflict of Interest:** None.

**References**

1. Sacks O (1986) The Man Who Mistook His Wife for a Hat, (L’uomo che scambia la moglie per un cappello) translated by Clara Morena, Collana Biblioteca n.174. Adelphi, Milano, Italy.
2. Alain Berthoz (2002) The Brain’s Sense of Movement. Harvard University Press, USA.
3. Crosson B, Hampstead BM, Krishnamurthy LC, Krishnamurthy V, McGregor KM, et al. (2017) Advances in neurocognitive rehabilitation research from 1992 to 2017: The ascension of neural plasticity. Neuropsychology 31: 900-920.
4. Dàvila Castrodad IM, Recai TM, Abraham MM, Etcheson JI, Mohamed NS, et al. (2019) Rehabilitation protocols following total knee arthroplasty: a review of study designs and outcome measures. Ann Transl Med 7: 255.
5. De Patre D, Van de Winckel A, Panté F, Rizzello C, Zernitz M, et al. (2017) Visual and Motor Recovery After “Cognitive Therapeutic Exercises” in Cortical Blindness: A Case Study. J Neurol Phys Ther 41: 164-172.
6. Sallès L, Martin-Casas P, Gironès X, Durà MJ, Lafuente JV, et al. (2017) Neurocognitive approach for recovering upper extremity movement following subacute stroke: A randomized controlled pilot study. J Phys Ther Sci 29: 665-672.
7. Cappellino F, Paolucci T, Zangrando F, Iosa M, Adriani E, et al. (2012) Neurocognitive rehabilitative approach effectiveness after anterior cruciate ligament reconstruction with patellar tendon. A randomized controlled trial. Eur J Phys Rehabil Med 48: 17-30.
8. Abraham A, Hart A, Andrade I, Hackney ME (2018) Dynamic Neuro-Cognitive Imagery Improves Mental Imagery Ability, Disease Severity, and Motor and Cognitive Functions in People with Parkinson's Disease. Neural Plast 2018: 6168507.
9. Marzetti E, Rabini A, Piccinni G, Piazza DB, Vulpiani MC, et al. (2014) Neurocognitive therapeutic exercise improves pain and function in patients with shoulder impingement syndrome: a single-blind randomized controlled clinical trial. Eur J Phys Rehabil Med 50: 255-264.
10. Zangrando F, Paolucci T, Vulpiani MC, Lamaro M, Isidori R, et al. (2014) Chronic pain and motor imagery: a rehabilitative experience in a case report. Eur J Phys Rehabil Med 50: 67-72.
11. Lephart SM, Pincivero DM, Giraldo JL, Fu FH (1997) The role of proprioception in the management and rehabilitation of athletic injuries. Am J Sports Med 25: 130-137.

12. Paolucci T, Zangrando F, Piccinini G, Sciarra F, Pallotta R, et al. (2016) A New Neurocognitive Interpretation of Shoulder Position Sense during Reaching: Unexpected Competence in the Measurement of Extra corporeal Space Biomed Res Int 2016: 9065495.