International
Journal of Neurorehabilitation

Carmelo C, Int J Neurorehabilitation 2015, 2:2
DOI: 10.4172/2376-0281.1000e107

Editorial Open Access

Bottom-Up or Top-Down Approach? Understanding the Way to Reach the Milestone of Recovery in Stroke

Chisari Carmelo*

Unit of Neurorehabilitation, University Hospital of Pisa, Italy
***Corresponding author:** Chisari Carmelo, Unit of Neurorehabilitation, University Hospital of Pisa, Italy, Tel: 39 050 221 2111; E-mail: c.chisari@ao-pisa.toscana.it

Rec date: Mar 26, 2015; **Acc date:** Mar 28, 2015; **Pub date:** April 03, 2015

Copyright: © 2015 Carmelo C. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Editorial

Stroke is the third most frequent cause of death worldwide and the leading cause of permanent disability in the USA and Europe. Stroke survivors can suffer several neurological deficits or impairments, such as hemiparesis, communication disorders, cognitive deficits or disorders in visuo-spatial perception. These impairments have an important impact in patient's life and considerable costs for health and social services. Moreover, after completing standard rehabilitation, approximately 50%-60% of stroke patients still experience some degree of motor impairment, and approximately 50% are at least partly dependent in activities-of-daily-living.

Evidences about post-stroke motor recovery in human and nonhuman animal models suggest that there is a 'sensitive period' post-stroke: first, almost all recovery from impairment occurs in the first 3 months after stroke in humans and in the first month after stroke in rodent models. Secondly, the effectiveness of post-stroke training with respect to impairment diminishes as a function of time after stroke in primates and in rodents. Therefore, there is a general concordance between animal and human studies that rehabilitation in the sensitive period is essential for significant recovery from impairment.

Up to now, a wide range of strategies and devices have been developed for the purpose of promoting motor recovery after stroke by taking advantage from the brain's ability to reorganize its neural networks after the injury. Traditional approaches towards rehabilitation can be qualified as "bottom-up" approaches in the sense that they act on the physical level and expect for changes at the central neural system level. Currently, robotic technologies and mechatronic devices represent the modern version of bottom-up treatment, offering the recognised advantage of providing quantifiable and repeatable task-specific assistance that ensure consistency during the rehabilitation and being cost-efficient.

The efficacy of the human-robot interactions that promote motor learning depends on the actions either imposed or self-selected by the user. Regarding current assistance strategies employed in robotic systems, the assist-as-needed control concept has emerged to encourage the active motion of the patient. In this concept, the goal of the robotic device is to either assist or correct the movements of the user. This approach is intended to manage simultaneous activation of efferent motor pathways and afferent sensory pathways during training. Current assist-as-needed strategies aim to provide the adequate definition of the desired limb trajectories regarding space and time the robot must generate to assist the user during the exercise.

Nevertheless, some authors argue that task-specific training alone is more likely to enhance behavioural compensation than effective recovery, highlighting the importance of providing the human equivalent of the "enriched environment" to augment the generalizing effect of spontaneous biological recovery instead of promoting compensation stretegies. From this point of view, Task-specific training is suggested to be delivered only if focused on tasks with the greatest chance of generalization (e.g., reaching and grasping) and if accompanied by other approaches able to augment, prolong, or mimic the poststroke sensitive period. These latter approaches comprise promising tools like plasticizing drugs or non-invasive brain stimulation techniques (Transcranial Magnetic Stimulation or transcranial Direct Current Stimulation): the so-called "top-down" approaches.

In this perspective, a better understanding of the central mechanisms underlying both spontaneous and training-guided recovery becomes mandatory in order to maximally take advantage from the brain capacity to reorganize its neural networks after a damage.

From this point of view, robotic rehabilitation provides the opportunity to put into practice new knowledge about neuroplasticity and sensory-motor learning because of the possibility to precisely quantify rehabilitation "dosage". Therefore, to ensure translation from laboratories to patients, the design and clinical evaluation of rehabilitation robots need to identify users' needs and be supported by neurophysiological assessment; namely, it is reasonable to expect a better insight in the understanding of the rehabilitative process if top-down approaches are considered. Besides, these new insights represent a crucial element to further improve the therapeutic options used in neurorehabilitation.

Future research would make possible the analysis of the impact of rehabilitation on brain plasticity in order to adapt treatment resources to meet the needs of each patient and optimize the recovery process.