

Article type: Perspective

Home Page URL: <https://www.alliedacademies.org/neurology-and-neurorehabilitation-research/>

Neuroplasticity and cognitive rehabilitation approaches in post-stroke executive function recovery.

Hiroshi Tanaka*

Department of Neurophysiology, Kyoto University, Japan.

*Correspondence to: Hiroshi Tanaka, Department of Neurophysiology, Kyoto University, Japan, E-mail: h.tanaka@kyoto-u.ac.jp

Received: 03-Oct-2025, Manuscript No. JNNR-25-171945; Editor assigned: 04-Oct-2025, PreQC No. JNNR-25-1719455(PQ); Reviewed: 18-Oct-2025, QC No JNNR-25-1719455; Revised: 21-Oct-2025, Manuscript No. JNNR-25-1719455(R); Published: 28-Oct-2025, DOI:10.35841/ aajnnr -10.4.273

Introduction

Stroke remains a leading cause of long-term neurological disability worldwide, often resulting in deficits in executive function, attention, and memory. Recovery is critically dependent on the brain's capacity for neuroplasticity, which allows reorganization of damaged networks and recruitment of compensatory pathways. Cognitive rehabilitation aims to strengthen these networks through targeted exercises, task-specific training, and environmental enrichment. Understanding the neural mechanisms underlying cognitive recovery is essential for designing effective interventions that optimize executive function and overall quality of life [1].

Neuroplastic changes following stroke involve both local and distant network adaptations. Functional imaging studies reveal that perilesional cortical regions and contralateral homologous areas often increase activation to compensate for impaired regions. Synaptic remodeling, dendritic sprouting, and enhanced connectivity within prefrontal and parietal networks contribute to the restoration of executive functions. Behavioral interventions that emphasize repetition, cognitive challenge, and feedback have been shown to potentiate these neural adaptations, reinforcing synaptic connections and promoting network integration [2].

Emerging technologies are increasingly integrated into cognitive rehabilitation. Computerized cognitive training programs, virtual reality exercises, and neurofeedback systems provide engaging, adaptive environments for patients to practice executive tasks. These tools allow precise monitoring of performance, real-time feedback, and progressive difficulty adjustment, optimizing learning and retention. Evidence suggests that combining these technologies with traditional rehabilitation enhances cortical recruitment and strengthens functional connectivity within executive networks, thereby improving attention, problem-solving, and working memory [3].

Non-invasive neuromodulation techniques further augment cognitive recovery. Transcranial direct current stimulation (tDCS) and repetitive transcranial magnetic stimulation (rTMS) applied to prefrontal or parietal regions can modulate cortical excitability and facilitate long-term potentiation. When paired with cognitive training, these methods enhance network plasticity and accelerate functional improvements. Pharmacological interventions targeting neurotransmitter systems involved in attention and learning, such as dopaminergic and cholinergic pathways, may provide additional support by optimizing synaptic responsiveness during rehabilitation [4].

Citation: Tanaka H. Neuroplasticity and cognitive rehabilitation approaches in post-stroke executive function recovery. *J Neurol Neurorehab Res.* 2025;10(4):273.

Despite progress, challenges remain in translating research findings into routine clinical practice. Individual variability in lesion location, stroke severity, and baseline cognitive capacity necessitates personalized intervention plans. Continuous assessment using neuroimaging, electrophysiology, and cognitive testing can guide therapy adaptation over time. Multidisciplinary collaboration among neurologists, neuropsychologists, therapists, and researchers is essential to maximize rehabilitation efficacy and ensure that interventions are both evidence-based and patient-centered [5].

Conclusion

Cognitive rehabilitation following stroke harnesses neuroplasticity to restore executive functions and improve daily functioning. By integrating targeted cognitive exercises, technology-based interventions, neuromodulation, and pharmacological support, rehabilitation programs can enhance network reorganization and functional outcomes. Personalized, evidence-driven approaches are

essential for optimizing recovery and promoting long-term independence in stroke survivors.

References

1. Salari N, Fatahi B, Valipour E, et al. Global prevalence of Duchenne and Becker muscular dystrophy: a systematic review and meta-analysis. *J Orthop Surg Res.* 2022;17(1):96.
2. Magot A, Wahbi K, Leturcq F, et al. Diagnosis and management of Becker muscular dystrophy: the French guidelines. *J Neurol.* 2023;270(10):4763-81.
3. Suntar I, Sureda A, Belwal T, et al. Natural products, PGC-1 α , and Duchenne muscular dystrophy. *Acta Pharm Sin B.* 2020;10(5):734-45.
4. Goodman CA, Coenen AM, Frey JW, et al. Insights into the role and regulation of TCTP in skeletal muscle. *Oncotarget.* 2017;8(12):18754.
5. Li M, Han Y, Wang S, et al. Becker muscular dystrophy: case report, review of the literature, and analysis of differentially expressed hub genes. *Neurol Sci.* 2022:1-1.

Citation: Tanaka H. Neuroplasticity and cognitive rehabilitation approaches in post-stroke executive function recovery. *J Neurol Neurorehab Res.* 2025;10(4):273.