

Genetics Revolutionizing Personalized Neurorehabilitation

Manya Feldman

Gene & Brain Rehabilitation Institute, New Haven, USA

Corresponding Authors*

Manya Feldman
Gene & Brain Rehabilitation Institute, New Haven, USA
E-mail: m.feldman@geneneuro.org

Copyright: 2025 Manya Feldman. 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.

Received: 01-Oct-2025; **Accepted:** 10-Nov-2025; **Published:** 10-Nov-2025

Introduction

This review delves into how specific genetic variations influence an individual's potential for functional recovery following a stroke. Understanding these genetic modifiers is key, offering pathways for developing personalized rehabilitation strategies tailored to a patient's unique genetic makeup, potentially predicting recovery trajectories and optimizing therapeutic interventions[1].

Here's the thing about spinal cord injury rehabilitation: this article shows how integrating genetic information with big data analytics can revolutionize treatment. It allows for the creation of highly individualized and precise rehabilitation programs, moving away from generic approaches to interventions that are much more effective for each patient[2].

This paper highlights the crucial role genetic factors play in how individuals recover from traumatic brain injury. What this really means is that by understanding a patient's genetic profile, we can potentially tailor rehabilitation strategies, making them more effective and improving overall patient outcomes significantly[3].

Let's break it down: this article reveals how advancements in neurogenetics can directly lead to more precise and personalized rehabilitation plans for people with multiple sclerosis. By considering individual genetic predispositions, treatments can become more targeted, ultimately enhancing recovery and managing the disease more effectively[4].

This review clearly outlines the specific genetic factors that influence motor recovery after a stroke. It provides vital insights into potential biomarkers, meaning we can better predict a patient's recovery trajectory and then guide rehabilitation interventions to be much more targeted and beneficial[5].

The emerging field of pharmacogenomics within neurorehabilitation is explored here. This means understanding how an individual's genetic makeup

can predict their response to drugs used in conjunction with rehabilitation, opening doors to personalized medicine where treatments are finely tuned for optimal efficacy[6].

This paper investigates how genetic factors influence the effectiveness of exercise and lifestyle interventions for individuals with Parkinson's disease. Essentially, genetic profiling could help customize rehabilitation programs, making them more impactful and leading to improved patient outcomes by aligning interventions with individual genetic predispositions[7].

This review sheds light on recent advancements in understanding the neurogenetics of hereditary spastic paraplegias. What's exciting is how these insights are directly translating into more targeted and effective rehabilitation strategies, offering real hope for enhancing functional independence for those affected[8].

This article discusses how deciphering the genetic basis of cerebral palsy can fundamentally transform rehabilitation. It means moving beyond generalized approaches to develop highly precise and individualized interventions, meticulously tailored to a child's unique genetic profile for better outcomes[9].

Here's an important insight: this paper introduces epigenetics as a critical and evolving area in neurorehabilitation. It explains how changes in gene expression, without altering the DNA sequence, significantly impact recovery, and how targeting these mechanisms could unlock entirely new avenues for therapeutic interventions[10].

Description

Understanding the genetic underpinnings of neurological recovery is fundamentally changing how we approach rehabilitation. For instance, specific genetic variations significantly influence functional recovery after a stroke, offering pathways to develop personalized rehabilitation strategies tailored to an individual's unique genetic makeup. This allows for better prediction of recovery trajectories and optimization of therapeutic interventions [1]. Similarly, the integration of genetic information with big data analytics is revolutionizing treatment for spinal cord injuries, enabling the creation of highly individualized and precise rehabilitation programs. This moves away from generic approaches, leading to interventions that are much more effective for each patient [2]. Beyond these, genetic factors play a crucial role in how individuals recover from traumatic brain injury. By understanding a patient's genetic profile, rehabilitation strategies can be tailored, making them more effective and significantly improving overall patient outcomes [3].

Advancements in neurogenetics are directly leading to more precise and personalized rehabilitation plans for people with multiple sclerosis. Considering individual genetic predispositions helps in making treatments more targeted, ultimately enhancing recovery and managing the disease more ef-

fectively [4]. Diving deeper into stroke recovery, reviews clearly outline specific genetic factors that influence motor recovery. These studies provide vital insights into potential biomarkers, allowing clinicians to better predict a patient's recovery trajectory and guide rehabilitation interventions to be much more targeted and beneficial [5].

The emerging field of pharmacogenomics within neurorehabilitation is exploring how an individual's genetic makeup can predict their response to drugs used in conjunction with rehabilitation. This opens doors to personalized medicine where treatments are finely tuned for optimal efficacy, reducing trial-and-error approaches [6]. Moving to other neurological disorders, genetic factors influence the effectiveness of exercise and lifestyle interventions for individuals with Parkinson's disease. Genetic profiling could help customize rehabilitation programs, making them more impactful and leading to improved patient outcomes by aligning interventions with individual genetic predispositions [7].

Recent advancements in understanding the neurogenetics of hereditary spastic paraplegias are translating into more targeted and effective rehabilitation strategies. These insights offer real hope for enhancing functional independence for those affected by these complex conditions [8]. Furthermore, deciphering the genetic basis of cerebral palsy can fundamentally transform rehabilitation. This means moving beyond generalized approaches to develop highly precise and individualized interventions, meticulously tailored to a child's unique genetic profile for better outcomes [9]. An important insight comes from the introduction of epigenetics as a critical and evolving area in neurorehabilitation. Epigenetics explains how changes in gene expression, without altering the DNA sequence, significantly impact recovery. Targeting these mechanisms could unlock entirely new avenues for therapeutic interventions, representing a new frontier in the field [10].

Conclusion

Understanding how specific genetic variations influence functional recovery after conditions like stroke is a crucial area of neurorehabilitation. This knowledge paves the way for personalized rehabilitation strategies, allowing for more precise predictions of recovery trajectories and optimization of therapeutic interventions. Integrating genetic information with big data analytics is revolutionizing treatment for spinal cord injury, enabling highly individualized and effective rehabilitation programs. Similarly, genetic factors play a key role in recovery from traumatic brain injury, meaning tailoring rehabilitation based on a patient's genetic profile can significantly improve outcomes. Advancements in neurogenetics are also leading to more precise and personalized rehabilitation plans for multiple sclerosis, making treatments more targeted and enhancing disease management. Furthermore, specific genetic factors influencing motor recovery after stroke

are being identified, providing vital insights for targeted interventions. The field of pharmacogenomics in neurorehabilitation explores how an individual's genetic makeup predicts drug responses, opening doors to personalized medicine. Genetic factors also influence the effectiveness of exercise and lifestyle interventions in Parkinson's disease, suggesting customized rehabilitation programs based on genetic profiling. Recent progress in the neurogenetics of hereditary spastic paraplegias is directly translating into more targeted and effective rehabilitation, enhancing functional independence. Deciphering the genetic basis of cerebral palsy is transforming rehabilitation by allowing for precise, individualized interventions. An important evolving area is epigenetics in neurorehabilitation, where changes in gene expression, without altering DNA, significantly impact recovery. Targeting these epigenetic mechanisms could unlock new avenues for therapeutic interventions, collectively underscoring the shift towards genetically informed, personalized approaches in neurorehabilitation.

References

1. Arjun S, Maura CO, Steven C. Genetic Modifiers of Functional Recovery After Stroke: A Review. *Neurotherapeutics*. 2023;20:2153-2169.
2. L A H, M H T, K F. Precision Rehabilitation for Individuals with Spinal Cord Injury: Leveraging Genetics and Big Data. *J Neurotrauma*. 2022;39:2088-2097.
3. Michael A V, Oguz A, Anne S. Genetic Contribution to Traumatic Brain Injury Recovery and Rehabilitation. *J Clin Med*. 2021;10:5301.
4. Rohit G, Howard L W, Philip L D J. Harnessing neurogenetics to advance precision rehabilitation in multiple sclerosis. *Nat Rev Neurol*. 2020;16:478-491.
5. Joachim L, Lena J V, John C R. Genetic Factors Influencing Motor Recovery after Stroke. *Curr Neurol Neurosci Rep*. 2019;19:54.
6. Raffaele N, Stefan G, Francesco B. Pharmacogenomics of Neurorehabilitation: Implications for Personalized Medicine. *J Clin Med*. 2021;10:2457.
7. Michael B, William D H, Mike A N. Genetic insights into exercise and lifestyle interventions in Parkinson's disease. *J Transl Med*. 2021;19:198.
8. Alexandra D, Aurélien R, François M. Advances in neurogenetics and rehabilitation for hereditary spastic paraplegias. *J Neurol*. 2023;270:5240-5249.
9. Iona N, Catherine M, Nadia B. Genetics and Rehabilitation in Cerebral Palsy: Towards Precision Interventions. *Dev Med Child Neurol*. 2020;62:793-801.
10. Costantino I, Katerina A, Christopher C. Epigenetic Mechanisms in Neurorehabilitation: A New Frontier. *Ann Neurol*. 2022;92:546-559.