Research Article

Journal of Surgery and Surgical Procedures

# Neuroplasticity and Relation to Aging

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Submitted : 3 Jul 2025 ; Published : 2 Aug 2025

**Citation:** Joon, K. (2025). Neuroplasticity and Relation to Aging. *J Sur & Surgic Proce.,3*(3):1-2.

**Abstract**

*This deals with the adaptive abilities of the brain and functional changes of the brain according to the structural changes. It occurs due to traumatic changes in brain.*

**Keywords:** Synaptic plasticity, neuro plasticity, supportive cells, cortex.

## Introduction

Neuroplasticity is defined as the ability of nervous system to change its activity in response to intrinsic and extrinsic stimuli by reorganizing its structure and function. It changes after traumatic brain injury (Physiopedia contributors, 2025).

## Mechanisms of Neuroplasticity

Neuroplasticity can be broken down into two major mechanisms:

- **Neuronal regeneration/collateral sprouting:** This includes concepts such as synaptic plasticity and neurogenesis.
- **Functional reorganization:** This includes concepts such as equipotentiality, vicariation, and diaschisis (Cherry & Lakhan, 2024).
- **Plasticity after injury:** Neuroplasticity is a complicated process that is still being elucidated; however, the concept can be applied in the setting of injury to the brain. Neuroplasticity is traditionally thought of as occurring in 3 phases or epochs.
- **First 48 hours:** Depending on the mechanism of the injury (such as stroke or TBI), there is initial damage that cumulates as cell death with the loss of certain cortical pathways associated with the lost neurons. The brain attempts to (health.clevelandclinic, 2023) use secondary neuronal networks to maintain function.
- **The following weeks:** Recruitment of support cells occurs in this period as the cortical pathways shift from inhibitory to excitatory. Synaptic plasticity and new connections are made during this period.
- **Weeks to months afterward:** The brain continues to remodel itself via axonal sprouting and further reorganization around the damage.

## Mechanisms of Neuroplasticity

1. Neuronal Regeneration/Collateral Sprouting (Rugnetta, 2025).

Synaptic plasticity: Synaptic plasticity is the ability to make experience-dependent long-lasting changes in the strength of neuronal connections. This is best expressed with the concept of long-term potentiation. First discovered in 1973 by Bliss and Lomo while studying the rabbit hippocampus, repetitive stimulation of presynaptic fibers resulted in high responses of granule cells of postsynaptic neurons. As the postsynaptic potential continued for a much longer time than expected, they termed this long-term potentiation. What is theorized to occur is that when the presynaptic neuron stimulates the postsynaptic neuron, the postsynaptic neuron responds by adding more neurotransmitter receptors, which lowers the threshold that is needed to be stimulated by the presynaptic neuron. This enhances the synapse over time in accordance with the idea by Konorski and Hebb. Synaptic plasticity can be positively influenced by several things, including, but not exclusively, exercise, the environment, repetition of tasks, motivation, neuromodulators like dopamine, and medications/drugs.Aging and neurodegenerative diseases have been associated with a decrease of neuromodulators and may contribute to a reduction in the ability of synaptic plasticity.The theory of synaptic plasticity has also grown to include more of the evolving complexity of synaptic communication.

These include:

- **Spike-timing-dependent plasticity (STDP):** This incorporates the timing of action potentials generated by presynaptic and postsynaptic neurons to explain how some synapses are strengthened and others are weakened.
- **Metaplasticity:** This broadens the concept to include networks and involves the activity-dependent changes in synapses and how they respond.
- **Homeostatic plasticity:** Mechanisms that maintain homeostasis of the synaptic network over time (Psychologytoday (n.d)).

Stemcell therapy cure of neuroplasticity

Pluripotent cells with neurogrowth hormone lead to growth of stem cells into the neuron and can lead to cure of dementia and neurodevelopmental cure.

## Discussion

We discussed about the neuronal plasticity and adaptive ability of the brain and cure of the traumatic neuronal injury.

## Conclusion

Neuronal plasticity is brain natural ability in response to traumatic brain injury and stem cell therapy can cure traumatic brain injury.

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