# Techniques and Methods for Altering Neurons

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## Abstract

Because neurons are not very good at regenerating, trauma and neurodegenerative illnesses of the Central Nervous System (CNS) are challenging to treat. A traditional strategy for neuroregeneration involves engrafting neural stem cells into the CNS. Despite significant advancements, functional integration and overcoming immune-rejection remain obstacles for stem cell therapy. In the adult mammalian CNS, a new development known as neuronal reprogramming transforms endogenous non-neuronal cells (such as glial cells) into mature neurons.

**Keywords:** Central nervous system neurodegenerative disease • *In vivo* reprogramming • Neuronal reprogramming • Astrocyte • Neuron

## Introduction

The primary components of the Central Nervous System (CNS) are glial cells and neurons. Neurodegenerative diseases are brought on by the degeneration or death of neurons at the sites of injury under pathological circumstances. For instance, particular subtypes of neurons die significantly in Huntington's disease and amyotrophic lateral sclerosis. Increases in evolutionary hierarchy are inversely connected with tissue regeneration capacity [1]. When neuronal cells degenerate or apoptose, it frequently results in a variety of functional deficiencies and the emergence of neurological disorders. A rodent model of Parkinson's disease may benefit from receiving transplants of embryonic tissue cells containing a high concentration of dopaminergic neurons. Patients' brains received transplants of healthy donor cells from particular areas of aborted foetal brains in order to replace diseased or dead cells. Although these trials offer significant support for alternative therapies, there are other factors to be concerned about, including immunological rejection and tumorgenicity. Human Embryonic Stem Cells (hESCs) have limited clinical applications because they need the destruction of blastocysts in order to use foetal tissue. Compared to other pluripotent stem cells, embryonic stem cells show a need for allogenic transplantation, which creates problems with immune rejection after transplantation and increases the appeal of obtaining hESCs from patients own somatic cells [2]. Moreover, with the increased attention, safety issues have also surfaced. The proliferative capacity of embryonic stem cells is unlimited. It has a double edge, though, as it might make something more likely to create tumours. The extremely effective differentiation of source cells into target neurons is one of the difficulties in the transplantation of human embryonic stem cells into the Central Nervous System (CNS). Due to the fact that they are derived from the embryo, ESCs also suffer from a supply issue that will restrict their use. Numerous exogenous cell therapies have been created due to the ethical restrictions of therapies generated from foetal tissue and stem cells. In the laboratory, stem cell treatment and induced Pluripotent Stem Cells (iPSCs) are now widely accepted as standard procedures for the healing of nerve damage and have the capacity to both repair damage and recreate neurotransmission pathways [3]. However, there are some pressing issues with the practical use of these protocols, including worries about heterogeneity, tumorgenicity, and its enormous time and effort requirements. When compared to embryonic stem cells, iPSCs are widely known for experiencing reduced immunological rejection. To create iPSCs, we can obtain a patient's own somatic cells [4]. The fact that each iPS cell line may not be exactly alike creates challenges for comparability and quality requirements [5].

## Description

### Reprogramming of the neurons

In comparison to cell transplantation techniques, neuronal reprogramming is more practical since it avoids many of their drawbacks, such as immunological rejection brought on by imported cells. Because astrocytes and neurons share the same progenitor cells and because astrocytes can be activated in response to injury to neurons and exhibit good plasticity, they are an excellent candidate for glial cell reprogramming. Additionally, because astrocytes are widely dispersed, the CNS can benefit from reprogramming into neurons. Astrocytes are therefore excellent candidates for reprogramming to aid in CNS damage repair. Reprogramming's implications are best appreciated in the context of organismal development. For instance, the proneural transcription factors Ascl1 and Ngn2 are crucial for embryonic neurogenesis in the CNS. The neural progenitor cells of the lateral ganglion protrusions create GABAergic neurons and striatal projection neurons in the basal ganglia when Ascl1 is expressed ventrally and induces the *Dlx* gene. By activating the NeuroD family of transcription factors, Ngn2 promotes the development of glutamatergic cortical projection neurons in the dorsal telencephalon. Accordingly, Ascl1 and Ngn2's usefulness in reprogramming technology may be strongly tied to their significant involvement in embryonic neurogenesis, which may elucidate processes underlying their widespread use.

### Positive aspects of neural remodelling

Since 2005, when this approach was initially disclosed, significant advancements have been made in neural reprogramming. In fact, the development of regenerative medicine for CNS injury and neurodegenerative illness has a bright future thanks to this technique. Neurodegeneration and CNS traumas can both be treated effectively with *in vivo* reprogramming. First, neurodegeneration and loss have been linked to a number of neurodegenerative illnesses. For instance, Huntington's disease and amyotrophic lateral sclerosis are linked to major decreases in GABAergic neurons and motor neurons, respectively, while Parkinson's disease is linked to the loss of dopaminergic neurons.

With the use of neuronal reprogramming technology, glia cells can be used to create a large number of new neurons, reducing neuron loss and promoting functional recovery. Reprogramming can also be used to model diseases for the creation of new medications and individualised therapies. Researchers can simulate disease and carry out extensive drug screening for patient-specific therapy using neurons reprogrammed from patient fibroblasts since they can exhibit individual characteristics. In addition, the majority of neurodegenerative disorders are age-related diseases, and directly converted neurons preserve the patient's age-related transcriptome characteristics, offering an age-specific model that can help with personalised drug therapy.

## Conclusion

Through the overexpression of different transcriptional factors or small chemicals, glial cells have been successfully converted into numerous varieties of neurons. Even if *in vivo* neural reprogramming is controversial, we still think that *in vivo* glia-to-neuron conversion holds promise for regenerative medicine. The assumption is that only by using trustworthy, exacting procedures in the research will this promising field have a healthy development.

In conclusion, as science and technology advance, a growing variety of treatment pathways and techniques enable the recovery from CNS injury and disease. In the future, spinal cord injury, traumatic brain injury, and neurodegenerative disorders may all be treated thanks to studies on neural reprogramming.

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