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# Parkinson's Disease and the Use of Stem Cells in its Treatment

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## DESCRIPTION

The motor syndrome of Parkinson's Disease (PD), a prevalent neurodegenerative condition, includes bradykinesia, rigidity, rest tremor, and, as the condition progresses, postural instability and falls. These motor symptoms make up the parkinsonian syndrome, which develops in Parkinson's disease (PD) as a result of the relatively selective death of dopaminergic neurons in the substantia nigra pars compacta, which lowers dopamine levels in the striatum. Neurodegeneration in other areas, such as the cerebral cortex, results in a range of additional non-motor symptoms. These comprise cognitive impairment, anosmia, sleep disruption, and neuropsychiatric symptoms. There has long been interest in whether the function of these neurons may be replaced by regenerative therapies that would increase dopamine levels in the brains of PD patients because the motor symptoms of PD are caused by the loss of a specific population of neurons. This chapter addresses some of the stem cell strategies being researched as potential ways to accomplish this as well as how they might fit into the future of PD management.

History of cell-based parkinson's disease therapies, Human Foetal Ventral Mesencephalon (FVM) research as a potential source of dopaminergic cells that may be grafted into PD patients attracted a lot of attention in the 1980s and 1990s. It had been observed in preclinical investigations that the dopaminergic cells in FVM grafts could survive and form synaptic connections in mouse brains, which could lead to improvements in motor and behavioural function. Human FVM grafting was started in patients after the positive outcomes of the preclinical studies, and several modest open-label trials were carried out in Sweden. The initial patients to receive such grafts did not improve, but by employing more tissue and tissue from an earlier gestational age, the majority of patients experienced clinical improvements, with some being able to stop taking their medications. Postmortem examination revealed that these grafts were able to endure for decades, despite 11% of the transplanted neurons developing Lewy body disease. Two sham surgery-controlled double-blinded trials were started in the USA as a result of the encouraging results from the Swedish trials. 56 individuals finally received human FVM transplants in these studies.

A second open-label experiment (TRANSEURO) was started in Europe (Clinical trials number NCT01898390), which is currently in its follow-up phase, after examination of all the data from the FVM trials that had been conducted. Patients have received a minimum of three foetal grafts on each side in this trial, along with 12 months of immunosuppression. Although the trial's findings have not yet been made public, a favourable outcome would be compelling indication that cell-based therapy can treat Parkinson's disease.

The encouraging results seen in the Swedish trials provided proof-of-principle that neural grafting could serve as the basis for an effective symptomatic treatment in PD, which is significant because it had become clear that FVM grafting was not scalable to be used as the mainline treatment for PD primarily due to logistical barriers and an inadequate supply of foetal tissue. It became evident that a sustainable source of dopaminergic neurons (or their progenitors) that could be grafted into a large number of patients was required. After stem cells were discovered, there was hope that they could meet this criteria, and stem cell-based methods are now the main focus of the field of regenerative therapeutics for Parkinson's Disease (PD).

Approaches based on stem cells, stem cells have the capacity to differentiate into any form of cell in the body and the capacity for endless self-replication. There are an infinite number of cells that could be employed for neural grafting because it is possible to influence the fate of these cells to become dopaminergic neurons. Embryonic Stem Cells (ESCs) and induced pluripotent stem cells are the most promising stem cell types when it comes to treating Parkinson's Disease (PD) (iPSC).

The role of stem cell treatments in parkinson's disease management, although stem cell-based treatments for Parkinson's disease present a number of difficulties, it appears likely that these therapies will eventually reach the clinic in the short- to medium-term. The field is now wondering how these therapies may be scaled and supplied, which shows the progress that has been made with these approaches, even though the

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creation of optimal goods has to be slow and iterative by necessity. As has been said, the main goal of stem cell therapies is to cure the motor symptoms of Parkinson's Disease (PD). They won't have any disease-modifying effects and won't cure the main non-motor symptoms, which in certain people can be extremely crippling. These methods may make up one component of PD treatment in the future, but they will probably be used in conjunction with other cutting-edge approaches that target the pathology of alpha-synuclein, such as immunotherapies and repurposed medications. While innovative disease-modifying medications could be utilized to stop continuing neuronal death, stem cell-based regenerative therapies may be able to restore function to dopaminergic neurons that have already been destroyed.