

Peripheral nerve regeneration using stem cell based artificial nerve grafts

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Traumatic peripheral nerve injuries can affect many functions of the human body (digestion, urination, etc.) and also impair mobility. Despite the fact that they possess the ability to heal on their own, the regeneration of some injuries can be extreme and might require surgery and transplantation of artificial nerve grafts. These artificial nerve grafts can be developed using stem cell-based techniques. The stem cells are cultured to become neural scaffolds that are biomaterial-based. These stem cells then develop into nerve grafts and are transplanted to the site of the injury. The transplantation promotes peripheral nerve regeneration by differentiating into Schwann cells and secreting neurotrophic factors.

One major source of the stem cells used in nerve regeneration is the human embryonic stem cells (hESCs). The morphological similarities of the hESCs with the Schwann cells and the ability of hESCs to form physical interactions with axons and to induce the myelination ganglia neurons are a few of the advantages of using hESCs in nerve grafts. Another major source includes neural stem cells which can also differentiate into Schwann cells and secrete neurotrophic factors.

Further, bone marrow mesenchymal stem cells, which are multipotent adult stem cells, can also be used for many reasons. One of them being that they are easy to obtain from many sources, such as bone marrow, peripheral blood, umbilical cord blood, lungs and fallopian tube. They are also efficient because they do not cause immune rejection as they are immunosuppressive in nature (can regulate immune system responses). Evidently, bone marrow mesenchymal stem cells can also differentiate into Schwann cells. Research also shows that in comparison to normal neural grafts, the grafts that are derived from bone marrow mesenchymal stem cells perform better in repairing damage and inducing axon growth.

There are many sources for neural stem cell regeneration and the prospects for it are excellent. However, there are several limitations associated with them, including, cell banks' need to maintain the quality, quantity and phenotypic stability of the stem cells, which is a very sensitive matter. The mobilisation and delivery methods of stem cell therapy also require further improvement to make sure that the stem cells stay viable. Nonetheless, there is a vast potential in stem cell therapy and there are several promising enhancements that this field brings to nerve graft tissue engineering.

Keywords: Stem cells, Tissue Engineering, Biotechnology, Nerve regeneration, Nerve grafts.

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