Neural graft

A **neural graft** refers to a biological or synthetic material used to repair or replace damaged nerve tissue, typically after an injury or in cases of neurodegenerative diseases. The goal of a neural graft is to promote nerve regeneration and restore lost function by providing structural support, biochemical signals, or a source of cells to facilitate tissue repair.

There are several types of neural grafts, including:

1. **Autografts**: These involve using a patient's own tissue, such as a portion of healthy nerve or skin, to repair the damaged area. Autografts are often considered the gold standard, as they reduce the risk of immune rejection, but they come with the disadvantage of donor-site morbidity.

2. **Allografts**: These grafts come from a donor of the same species. They may carry a risk of immune rejection, which can require immunosuppressive drugs.

3. **Xenografts**: These are grafts taken from a different species (e.g., from animals like pigs) and are used in some experimental settings. Xenografts face significant challenges related to immune rejection.

4. **Acellular grafts**: These are grafts that are devoid of living cells but retain extracellular matrix components, which provide a scaffold for cell migration and nerve regeneration. These grafts may be derived from natural materials, such as collagen or chitosan, or synthetic polymers.

5. **Cell-based grafts**: These grafts use living cells, such as stem cells, Schwann cells, or other cell types, to promote nerve regeneration. These cells can secrete growth factors and form new neural tissue. Mesenchymal stem cells (MSCs), for instance, have been studied for their potential in nerve repair due to their ability to differentiate into various cell types and promote healing.

6. **Bioengineered grafts**: These are designed using a combination of biomaterials, cells, and/or growth factors to mimic the natural environment of nerve tissue. These grafts may be fabricated in laboratories using techniques like 3D printing to achieve more tailored solutions for nerve repair.

A study explores the efficacy of a neural graft constructed using adipose mesenchymal stem cells (ADSC), acellular microtissues (MTs), and chitosan in the treatment of peripheral nerve defects.

Stem cell therapy with acellular MTs provided a suitable microenvironment for axonal regeneration and compensated for the lack of repair cells in the neural ducts of male 8-week-old Sprague Dawley rats.

In vitro, acellular MTs retained the intrinsic extracellular matrix and improved the narrow microstructure of acellular nerves, thereby enhancing cell functionality. In vivo, neuroelectrophysiological studies, gait analysis, and sciatic nerve histology demonstrated the regenerative effects of active acellular MT. The Chitosan + Acellular-MT + ADSC group exhibited superior myelin sheath quality and improved neurological and motor function recovery.

Active acellular-MTs pre-cellularized with ADSC hold promise as a safe and effective clinical method for peripheral nerve defect treatment [1).

The study on the chitosan/acellular matrix-based neural graft carrying mesenchymal stem cells presents a promising approach for enhancing peripheral nerve repair. The combination of adipose-derived stem cells (ADSC) and acellular microtissues (MTs) encapsulated in chitosan scaffolds demonstrated positive outcomes in both in vitro and in vivo models, showing improved nerve regeneration, myelin sheath quality, and functional recovery. These results suggest that this innovative graft could provide a potential solution for treating peripheral nerve defects.

However, the study's impact is limited by certain weaknesses, such as the lack of detailed control groups, short-term follow-up, and insufficient mechanistic insights into the regeneration process. Further studies, including long-term evaluations, larger sample sizes, and a more thorough understanding of the cellular mechanisms, are necessary to confirm the clinical applicability and safety of this approach in humans. Despite these limitations, the study lays a promising foundation for future research in regenerative medicine and peripheral nerve repair.

[1]
Zhang Z, Li M, Cheng G, Wang P, Zhou C, Liu Y, Duan X, Wang J, Xie F, Zhu Y, Zhang J. A chitosan/acellular matrix-based neural graft carrying mesenchymal stem cells to promote peripheral nerve repair. Stem Cell Res Ther. 2024 Dec 31;15(1):503. doi: 10.1186/s13287-024-04093-5. PMID: 39736729.