Acellular microtissue

An **acellular microtissue** refers to a tissue-like structure that mimics the mechanical, biochemical, or functional properties of a biological tissue but is devoid of living cells. These microtissues can be constructed using a variety of non-cellular components, such as extracellular matrix (ECM) proteins, synthetic polymers, or other biomaterials, and are often used in research and medical applications.

The acellular nature of these microtissues allows researchers to study tissue functions and interactions in a controlled environment without the complexity and variability of living cells. They can be used to simulate various biological processes, such as tissue remodeling, drug testing, or the development of implants and prosthetics. Acellular microtissues are particularly relevant in areas like tissue engineering, regenerative medicine, and the development of models for disease research.

Some common examples of acellular microtissues include:

1. **Acellular scaffolds** are used in tissue regeneration, where the scaffold mimics the structure of natural tissue and provides support for cells to grow when they are later introduced.

2. **Acellular matrices** derived from decellularized tissues, where all the cellular components are removed, leaving behind the ECM that retains some of the tissue's original properties for use in various biomedical applications.

These microtissues are valuable for testing therapeutic interventions, creating advanced biomaterials, and providing insights into tissue function without relying on the complexities of living cells.

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.