Dental Pulp Stem Cells

- Application of dental pulp stem cell-conditioned medium combined with deep cryopreservation of autologous cranial flaps
- Crosslinker-free in situ hydrogel induces self-aggregation of human dental pulp stem cells with enhanced antibacterial activity
- Dental Pulp Stem Cells Attenuate Early Brain Injury After Subarachnoid Hemorrhage via miR-26a-5p/PTEN/AKT Pathway
- Noggin Combined With Human Dental Pulp Stem Cells to Promote Skeletal Muscle Regeneration
- The safety and efficacy of stem cell therapy for diabetic peripheral neuropathy in animal studies: A systematic review and meta-analysis
- Stem Cells Treatment for Subarachnoid Hemorrhage
- Sequencing-based study of neural induction of human dental pulp stem cells
- Dental pulp mesenchymal stem cell-derived exosomes inhibit neuroinflammation and microglial pyroptosis in subarachnoid hemorrhage via the miRNA-197-3p/FOXO3 axis

Dental Pulp Stem Cells (DPSCs) are mesenchymal stem cells (MSCs) found in the dental pulp, the soft connective tissue inside teeth. First discovered in 2000, DPSCs have gained attention for their high proliferative potential, multipotency, and ability to differentiate into various cell types.

Sources

- **Primary teeth (deciduous teeth)** – Also known as **SHED (Stem Cells from Human Exfoliated Deciduous Teeth)**. - **Permanent teeth** – Typically extracted wisdom teeth or third molars. - **Supernumerary teeth** – Extra teeth that sometimes develop. - **Root apex of developing teeth** – The apical papilla contains a rich source of stem cells.

Properties

1. **High Proliferation Rate** – Compared to bone marrow-derived mesenchymal stem cells (BM-MSCs), DPSCs show greater clonogenic potential. 2. **Multipotency** – Can differentiate into:

1. Odontoblasts (dentin-producing cells)
2. Osteoblasts (bone cells)
3. Chondrocytes (cartilage cells)
4. Adipocytes (fat cells)
5. Neurons (nerve cells)
6. Myocytes (muscle cells)

3. **Immunomodulatory Effects** – DPSCs secrete anti-inflammatory cytokines, reducing immune responses and promoting tissue repair. 4. **Angiogenic Potential** – Can promote the formation of new blood vessels. 5. **Neurotrophic Properties** – Release neurotrophic factors beneficial for neuroprotection and regeneration.

Applications

1. Regenerative Dentistry - **Pulp Regeneration** – DPSCs can regenerate damaged or necrotic dental pulp. - **Dentin Repair** – Can differentiate into odontoblast-like cells to repair dentin defects. - **Periodontal Regeneration** – Helps in the treatment of periodontitis and regeneration of periodontal ligaments.

2. Bone and Cartilage Regeneration - **Bone Tissue Engineering** – DPSCs can form mineralized structures, making them useful in maxillofacial and orthopedic applications. - **Osteoarthritis Treatment** – Used in cartilage regeneration therapies.

3. Neurological Disorders - **Stroke Therapy** – DPSCs can enhance neurogenesis and repair brain damage post-stroke. - **Spinal Cord Injury** – Potential use in spinal cord repair due to neurotrophic factors. - **Neurodegenerative Diseases** – Research suggests DPSCs may help treat Alzheimer’s and Parkinson’s diseases.

4. Cardiovascular Regeneration - **Myocardial Infarction** – DPSCs secrete growth factors that may help in cardiac tissue repair.

5. Immune Modulation and Autoimmune Diseases - **Graft-versus-Host Disease (GVHD)** – DPSCs have immunosuppressive properties useful for GVHD therapy. - **Type 1 Diabetes** – Studies show potential in regenerating insulin-producing β-cells.

6. Wound Healing and Skin Regeneration - **Diabetic Ulcers** – Helps accelerate wound healing. - **Burn Treatment** – Can promote tissue regeneration.

Advantages of DPSCs Over Other Stem Cells

- **Non-invasive Collection** – Easily obtained from extracted teeth. - **Higher Proliferation and Differentiation Rates** – More potent than BM-MSCs in some studies. - **Lower Immunogenicity** – Reduces risk of immune rejection. - **Ethical Considerations** – Less controversial compared to embryonic stem cells (ESCs).

Challenges and Limitations - **Standardization Issues** – Lack of universally accepted protocols for DPSC isolation and expansion. - **Long-term Safety** – More studies needed to assess potential risks, such as tumorigenicity. - **Storage and Banking Costs** – Cryopreservation of DPSCs requires specialized facilities.

Future Perspectives - **Bioprinting and Tissue Engineering** – Combining DPSCs with biomaterials for 3D printing of organs. - **Gene Editing (CRISPR/Cas9)** – Enhancing DPSC function for targeted therapy. - **Clinical Trials** – Ongoing research exploring the full therapeutic potential of DPSCs in regenerative medicine.

Conclusion

Dental Pulp Stem Cells hold immense promise for regenerative medicine, with applications ranging from dentistry to neurology and immunotherapy. Despite challenges, advancements in stem cell

technology and biomaterials will likely accelerate their clinical translation in the coming years.

Preclinical experimental studies

He et al. aim to investigate whether DPSCs can improve early brain injury after subarachnoid hemorrhage, and explore the mechanisms. In the study, they utilized the endovascular perforation method to establish a subarachnoid hemorrhage mouse model and investigated whether DPSCs administered via tail vein injection could improve EBI after SAH. Furthermore, we used hemin-stimulated HT22 cells to simulate neuronal cell injury induced by SAH and employed a co-culture approach to examine the effects of DPSCs on these cells. To gain insights into the potential mechanisms underlying the improvement of SAH-induced EBI by DPSCs, we conducted bioinformatics analysis. Finally, we further validated our findings through experiments. In vivo experiments, we found that DPSCs administration improved neurological dysfunction, reduced brain edema, and prevented neuronal apoptosis in SAH mice. Additionally, we observed a decrease in the expression level of miR-26a-5p in the cortical tissues of SAH mice, which was significantly increased following intravenous injection of DPSCs. Through bioinformatic analysis and luciferase reporter assay, we confirmed the target relationship between miR-26a-5p and PTEN. Moreover, we demonstrated that DPSCs exerted neuroprotective effects by modulating the miR-26a-5p/PTEN/AKT pathway. Our study demonstrates that DPSCs can improve EBI after SAH through the miR-26a-5p/PTEN/AKT pathway, laying a foundation for the application of DPSCs in SAH treatment. These findings provide a theoretical basis for further investigating the therapeutic mechanisms of DPSCs and developing novel treatment strategies in SAH [1].

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He P, Zhang H, Wang J, Guo Y, Tian Q, Liu C, Gong P, Ye Q, Peng Y, Li M. Dental Pulp Stem Cells Attenuate Early Brain Injury After Subarachnoid Hemorrhage via miR-26a-5p/PTEN/AKT Pathway. Neurochem Res. 2025 Jan 30;50(2):91. doi: 10.1007/s11064-025-04340-y. PMID: 39883266.