

A Systematic Review of Dental Stem Cells for Regenerative Dentistry: Challenges and Future Directions

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Structured Abstract:

Background: Stem cell therapy is a promising innovation in regenerative medicine, offering novel approaches for tissue repair and restoration. Among various stem cell types, dental stem cells (DSCs) have gained attention due to their accessibility, high proliferation rates, and neurotrophic properties. However, despite potential, several challenges remain unaddressed, including the effective integration of DSCs into oral tissues and their differentiation into specific cell lines. This study focuses on overcoming these challenges and exploring the strategies to enhance the clinical applicability of DSC-based regenerative treatments in dentistry and oral medicine.

Methods: This systematic review adhered to PRISMA guidelines and involved a comprehensive search across four major databases: ScienceDirect, Web of Science, SCOPUS, and PubMed. The keywords used were “dental”, “stem cells”, “regenerative”, and “dentistry”. The search spanned from 2019 to 2024. A total of 165 articles were retrieved. After removal of duplicates, 115 articles were screened by title and abstract, and 52 full-text articles were selected based on inclusion and exclusion criteria for qualitative synthesis.

Results: Analysis of recent studies provided insights into the comparative evaluation of DSCs and other stem cell types such as BMSCs in dental tissue engineering. The review identified critical elements affecting DSC integration into host tissues, including immune modulation, vascularization, scaffold design, and delivery mechanisms. Furthermore, the role of exosome-based therapies and advanced biotechnological tools such as 3D bioprinting and nanofiber scaffolds were highlighted as emerging strategies for enhancing regenerative outcomes.

Conclusion: In conclusion, the findings of this study indicated that DSCs show significant promise in regenerative dentistry, but clinical translation is limited by biological, technical, and regulatory barriers. Improving integration strategies, standardizing protocols, and leveraging biotechnology are essential for advancing stem cell-based dental therapies.

Keywords: Dental stem cells, Regenerative dentistry, Exosomes, Bioprinting, PRISMA

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