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Mini Review
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Secretome Derived From Dental Pulp Stem Cells and Its Capacity for Regeneration

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Abstract

In-depth study is being done on the secretome formed from dental pulp a stem (DSC) cell, which is made up of a variety of biomolecules, and its therapeutic potential. Because the paracrine effect of the bioactive factors secreted by human dental pulp stem cells (hDPSCs) and human exfoliated deciduous teeth (SHEDs) is not fully understood, the majority of DSC secretome-based therapies have not been applied in human medicine, despite promising in vitro and in vivo studies. We summarise the available research on the secretome produced from hDPSC and SHED as a possible participant in the regeneration of bone, cartilage, and nerve tissue in this review. According to published studies, dental MSC-derived secretome/conditional medium can regulate neuroprotective, anti-inflammatory, anti-apoptotic, and angiogenic processes through secretome paracrine mechanisms, which may be useful in treating neurodegenerative diseases, neural injuries, cartilage defects, and bone repair. Similar to bone marrow MSC-secretomes, dental MSC-secretomes engage cellular and molecular pathways that affect how well cell-free therapy works. The multidirectional paracrine effect that dental MSC-derived secretomes have been shown to have in the treatment of numerous different wounded tissues is emphasised in many papers as having potential applications in tissue-regenerating therapy [1].

Keywords: Dental stem cells; Paracrine effect; Regenerative medicine; Secretome

Introduction

Dental stem cells (DSCs), a significant source of mesenchymal stem cells (MSCs), are readily accessible through minimally invasive procedures and have been used to treat a number of disorders. Modern understanding of the indirect paracrine effect has shed new light on the riddle of their actual low engraftment and differentiation capabilities in vivo. The classic paradigm attributed the mechanism of their therapeutic action to direct cell differentiation following focused migration. A growing number of in vivo studies have linked DSC-derived extracellular vesicles (DSC-EVs), which are essential paracrine effectors, to the beneficial effects of DSCs. DSC-EVs have been introduced as prospective remedies since they include bioactive materials and have therapeutic promise in some disorders [2]. Here, we thoroughly examine the most recent in vivo data that backs up the therapeutic benefits of DSC-EVs through mechanistic research. In addition, current challenges and future directions for the clinical translation of DSC-EVs are also highlighted to call for more attentions to the (I) distinguishing features of DSC-EVs compared with other types of MSC-EVs, (II) heterogeneity among different subtypes of DSC-derived EVs, (III) action modes of DSC-EVs, (IV) standardisation for eligible DSC-EVs and (V) safety guarantee for the clinical application of DSC-EVs. The current review will shed important light on the potential uses for DSC-EVs in upcoming clinical trials. Pulpitis, pulp necrosis, and eventually pulp loss are caused by deep cavities, injury, and severe periodontitis. However, missing pulp cannot be replaced by any clinical treatment. It is urgently necessary to develop a unique pulp regeneration strategy for clinical use. The ability of dental stem cells to regenerate tissue is controlled by signalling transduction [3]. The migration, proliferation, odontogenic differentiation, pro-angiogenesis, and pro-neurogenesis potentials of dental stem cells can all be stimulated by cytokines or growth factors, such as stromal cell-derived factor (SDF), fibroblast growth factor (FGF), bone morphogenetic protein (BMP), vascular endothelial growth factor (VEGF), and WNT. In numerous preclinical studies of pulp regeneration based on cell transplantation or cell homing, signalling modulation techniques including growth factor delivery, genetic alteration, and physical stimulation have been used. The root canal's vascularized pulp-like tissue was repaired by implanting dental stem cells and growth factors in a scaffold. Additionally, endogenous stem/progenitor cells were drawn to a flow-able scaffold by chemokine injection for pulp regeneration. Notably, the clinical stage of tooth pulp regeneration has gradually advanced [4]. These results shed light on a unique approach for the spatial and temporal complex control of signalling transduction by clinically appropriate growth factors delivery for structural and functional pulp regeneration.

Discussion

Stem cells have been suggested for use in regenerative medicine over the past ten years, with mesenchymal stem cells (MSCs) garnering the majority of the attention due to their therapeutic potential in tissue engineering and regenerative medicine. When MSCs were first used therapeutically in regenerative medicine, they were delivered directly to the wounded tissue and differentiated into several functional cell types, which facilitated tissue repair and regeneration. The second method was tissue engineering, which created a tissue structure by fusing stem cells or differentiated cells with a biodegradable framework. MSCs taken from bone marrow have been used in the majority of clinical trials. It is important to note that MSCs obtained from human dental pulp tissue have also been used as a regenerative medicine technique in clinical studies. Clinical data continue to demonstrate the efficacy of MSC applications, and The National Institutes of Health's database, has a list of completed experiments. Reports also indicate that MSCs derived from various sources are successful in tissue regeneration,

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although their use in regenerative medicine is currently constrained by a number of significant barriers [5-8].

One of the main reasons for the loss of tooth-supporting tissues is inflammatory periodontal disease. In-depth study is being done on novel methods for periodontal apparatus regeneration. The employment of appropriate regenerative cells, transported through a suitable scaffold, and guided by signalling molecules is implied by periodontal tissue engineering. An increasing number of studies on dental tissue engineering have utilised dental pulp stem cells. These cells have mesenchymal (stromal) stem cell-like traits, such as the capacity for self-renewal and multi-lineage differentiation, in addition to being relatively accessible and easy to handle [9]. This article's goal is to cover the scientific underpinnings of periodontal tissue engineering as well as the difficulties in creating a reliable and clinically useful platform for tissue regeneration. An updated review of dental pulp is provided in this piece.

Conclusion

The soft living tissue inside teeth known as the dental pulp contains stem cells known as dental pulp stem cells (DPSCs). Dental pulp can be used for DPSC collection using a non-invasive technique. It can be done on an adult after a straightforward extraction or on a young person after a surgical wisdom tooth extraction. They are pluripotent because they can grow into formations that resemble embryoid bodies (EBs) in a lab setting and teratoma-like forms when injected into naked mice. In ex vivo cultures, dental pulp progenitor cells have the best proliferation and differentiation potential, making them the most appealing cells for periodontal tissue creation. first revealed how mesodermal tissues give rise to dental pulp progenitor cells. They share a family tree with mesenchymal stem cells (MSC), which are found in the stromal compartment of several organs, including bone marrow. DPSCs have the ability to differentiate in vitro into tissues that resemble the mesoderm, endoderm, and ectoderm layers [10]. They can differentiate into a variety of cell types, including adipocytes, osteoblasts, neural progenitors, osteoblasts, and osteoblasts. It was discovered that DPSCs can develop into neural-like cells and adipocytes. Researchers now have a non-invasive way to collect stem cells from teeth, including postnatal teeth, wisdom teeth, and deciduous teeth. The degree to which these changes can be linked to tissue of origin, function, or culture circumstances is not evident, but the various cell populations do differ in several elements of their growth rate in culture, marker gene expression, and cell differentiation. DPSCs have therefore been viewed as a very potential source of cells.

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