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Review Article

Dental Pulp Stem Cells: A Review

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Abstract

Stem cells are unique cells and reproducible cells that can be useful as a good alternative to future therapies in the field of Dentistry. Some body cells, including blood cells and nerve cells, cannot be replaced, and stem cells play an important role in this procedure, which can help to replace cells, while stem cells can be used as alternate cells several times, and this act of replacing damaged cells called proliferation. The development of Dental stem cell banks in the future for right and suitable costs will help to obtain stem cell induction. Accelerating information and new methods and prospective clinical approaches are important and can play a critical role in stem cell therapy for future treatment modality at dental medicine.

Keywords: Stem Cells; Pulp; Enamel; Dentin

Introduction

Stem cells are a type of cells that could be used to repair area or parts of the body need to be restored. They play an important and critical role in restoring the mouth, including hard and soft tissues. With the progress of medical and dental sciences, stem cells could be alternatives to previous treatments involving various oral and maxillofacial areas as well as regenerative of the jawbone and adipose tissue. Understanding tooth physiology and structure is important so that it can play an important role in diagnosis and treatment plan.

The tooth has a multi-layered structure including Enamel, Dentin, periodontal ligament, root canal and Pulp in the inner region (Figure 1). The main reason of many oral and dental problems after periodontal problems is the decay and inflammation of the tooth pulp which is ultimate leads to do endodontic treatment.

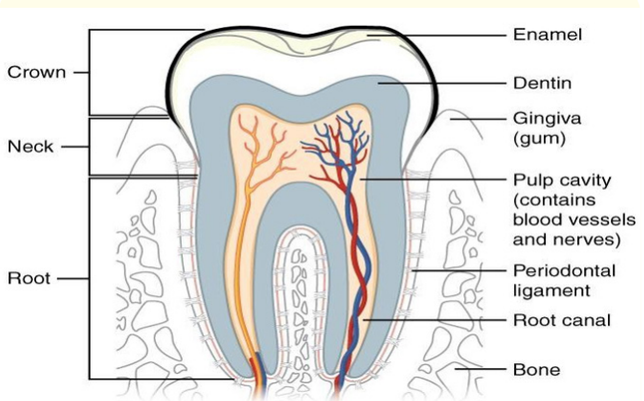

Figure 1: Tooth structure.

Dental pulp is located in the central pulp cavity of each tooth, called the "pulp chamber," and contains a heterogeneous population represented by fibroblasts, endothelial cells, neurons, odonto-osteoprogenitors, inflammatory and immune cells [1,2]. Recently, it has been demonstrated that dental pulp stem cells (DPSCs) seeded on porous surfaces, shown osteoblast differentiation, production of appreciable amounts of bone morphogenetic proteins as well as vascular endothelial growth factor and specific bone proteins [3].

Stem cells and dental medicine

The stem cell is defined as a cell that can continuously produce unaltered daughters and, furthermore, has the ability to generate cells with different and more restricted properties [4]. Because of their unique properties, stem cells have the potential to be important in tissue engineering strategies for the regeneration of diseased, damaged, and missing tissues and even organs [5]. Two broad types of stem cells found in people are adult stems cells and embryonic stem cells (Figure 2) [6].

Embryonic stem cells are self-replicating pluripotent cells that are potentially immortal [7]. Adult stem cells are undifferentiated totipotent or multipotent cells, found throughout the body after embryonic development that multiply by cell division to replenish dying cells and regenerate damaged tissues [8].

Over the last few years, dentistry has begun to explore the potential application of stem cells and tissue engineering towards the repair and regeneration of dental [9]. We have different source of dental stem cells which is the third molar are the universal source of DPSCS [10] and Canines and incisors are a rich source of stem

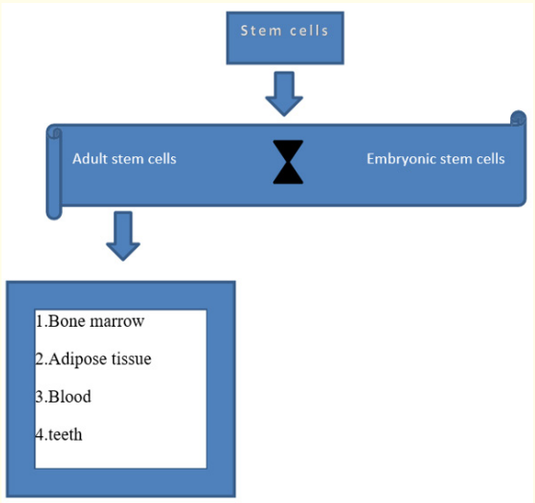

Figure 2: Types of stem cells.

cells in the deciduous dentition [11]. There are different types of dental stem cells that have been characterized include (Figure3) [12-16]

- DPSCs: Dental Pulp stem cells.
- DFPCs: Dental follicular precursor cells.
- SHEDs: Stem cells from Exfoliated deciduous teeth.
- SCAPs: Stem cells from apical papilla.
- PDLSCs: Periodontal ligament stem cells

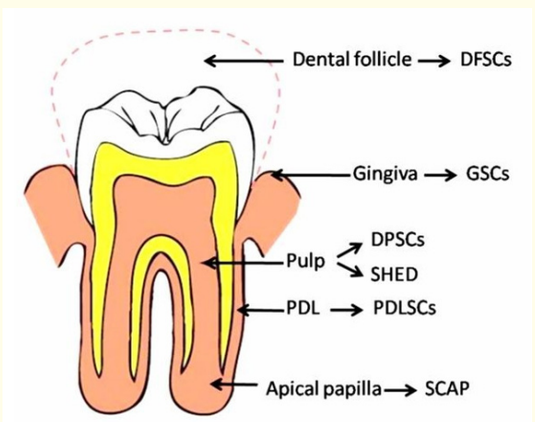

Figure 3: Different types of dental stem cells (Adapted from (Yvonne wai yeepang, 2015).

Dental pulp stem cells

Two main cell types involved in dental tissue formation: the ameloblasts, of epithelial origin that form enamel and the odontoblasts of mesenchymal origin in which are responsible for dentin production [17]. Ameloblastin, an enamel matrix protein, is expressed by differentiating ameloblasts and is essential for dental epithelial cell differentiatin into ameloblast and enamel formation [18,19]. The odontoblast is a hard component of the tooth that surrounds the dental pulp.

Dental pulp stem cells (DPSCs) are a promising source of cells for numerous and varied regenerative medicine applications [20]. These stem cells are found to reside in the central cell rich zone of the pulp [21]. DPSCs can be cryopreserved and revived whenever they are needed for future regenerative therapies [22,23].

It has been shown that the DPSCs can be differentiated by modulation with growth factors, transcriptional factors, extracellular matrix proteins and receptor molecules into different cell types include odontoblast, osteoblast, chondrocyte, cardiomyocytes, neuron cells, adipocyte, corneal epithelial cell, melanoma cell and insulin secreting beta cells [24]. DPSCs are more easily sourced as they can be obtained from sound teeth that are deemed for extraction for orthodontic or periodontal reasons [25]. In recent decade, continuous attempted improvements in the transplantation methods of DPSCs into ectopic animal models have yielded numerous favorable results supporting the potential of dental pulp-derived stem cells in regenerating vascularized dentin/pulp tissue, whether or not incorporating scaffolds, whether casting scaffolds within pulp chamber of tooth slices or emptied root canals [26-29].

Advantages of dental pulp stem cells

High poliferative rates [30], Ethical concern [31], clone forming ability [32] and mineralized tissue formation [33].

Disadvantages of dental pulp stem cells

Large range of growth rates, different cell morphologies and sizes, need to be obtained from healthy adult teeth [34].

Regenerative potential for dental pulp stem cells

Currently, dental research applies tissue engineering protocols and explores the potential of cell- based products as alternative therapies to replace tissues such as pulp, dentin and bone [35-37]. Tissue engineering is an emerging interdisciplinary science that applies the principles of biology and engineering in regenerative medicine to improve or replace the biological function of cells, tissues and organs damaged by intrinsic or extrinsic factors [38-42]. The dental pulp is a richly vascularized and innervated connective tissue comprising heterogeneous cell populations, among which stem/progenitor cells are anticipated to constantly replenish odontoblasts to form secondary and tertiary/reparative dentin throughout adult life [43].

The initial identification by Gronthos et al. of this cell population was based on the traits of single- colony formation in culture self-renewal and differentiation into different cell lines [44]. DPSCs are readily available from exfoliating/extracted teeth that are otherwise discarded as medical waste and its rapid proliferation provides a potential for expansion [45]. Stem cell based regenerative therapies certainly hold much potential in the treatment of medical and dental conditions [46].

Future work

Previous research in dental regenerative medicine showed not only the feasibility of transplantation for stem cells, but also organ replacement, earlier than for other organs [47].

Recent studies have demonstrated that tooth-driven stem cells promoted strong neuro regenerative activities that fulfil many requirement for functional recovery after spinal cord injury [48].

The future of tissue engineering is in dentistry. With stunning advances in genetic, cellular and molecular biology, tissue engineering and tissue regeneration for the treatment of periodontal problems, enamel, dentin and pulp will be possible with new methods. Stem cell therapies Cost is a major factor in the subject of treatments and should try to resolve the cost problem. since the clinical part of stem cell therapies is an important debate in this field, we must find appropriate solutions for the development of this section. Although it is difficult to predict how stem cells affect in dentistry at the future, we should be hope full to find precise ways to develop this science.

Conclusion

The development of Dental stem cell banks in the future for right and suitable costs will help to obtain stem cell induction. Accelerating information and new methods and prospective clinical approaches are important and can play a critical role at stem cell therapy for future treatment modality at dental medicine.

DPSC have unique properties, which make them more effective in the protection and repair of neural cells and tissue than other adult stem cells [49]. with the advancement of dental sciences and improvement of the quality of work in the future especially stem cell therapies it is hoped to use dental pulp stem cells to repair parts that require at the oral and maxillofacial region.

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