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Review Article

Miracle cells for natural dentistry – A review

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ABSTRACT

Stem cells are undifferentiated cells that can differentiate into specialized cells. Recently, enormous growth has been seen in the recognition of stem cell-based therapies, which have the potential to ameliorate the life of patients with conditions that span from Parkinson's disease to cardiac ischemia to bone or tooth loss. This research has produced new but unexplored possibilities in the regeneration of different organs and tissues. Presently, research is focused on the proficiency of stem cells and their utilization in dentistry, which is gaining interest. The tooth is nature's "esteem" for these precious stem cells and there are a number of these cells in permanent and primary teeth, as well as in the wisdom teeth. Dental stem cells are easy, convenient, and affordable to collect. They hold promise for a range of very potential therapeutic applications, such as in the treatment of cancer, spinal cord injury, brain damage, myocardial infarction, hearing loss, diabetes, wound healing, baldness, etc. Since these cells were used to regenerate damaged tissue in medical therapy successfully, it is possible that the dentist in future might use stem cell to regenerate lost or damaged dental and periodontal structures. This paper reviews the current concepts, characteristics of stem cells in regeneration, and its subsequent uses in dentistry.

1. Introduction

Stem cells are unique type of cells that have specialized capacity for self-renewal and potency, and can give rise to one and sometimes many different cell types. They are found in many of the multicellular organisms and have the ability to renew through mitotic cell division and even maintain the original undifferentiated state.[1] On cell divison, each new cell has the potential to either remain a stem cell or become another type of cell with a more specialized function, such as a cardiac muscle cell, skeletal muscle cell, liver cell, a red blood cell, a brain cell, etc.[2] Stem cells have two paramount characteristics that differentiate it from other cells. The first is "*self-renewal*," i.e., the ability of renewing themselves through cell division, sometimes after long periods of inactivity. The second is "*potency*," i.e., they can be induced to become tissue-specific cells with special functions, under

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certain physiologic or experimental conditions. In some organs, such as the bone marrow, they regularly divide to repair and replace worn out or damaged tissues.[3]

In medical therapy, stem cells have been used for engineering many tissues and organs. Stem cell therapy has also been used to treat diseases including Parkinson's and Alzheimer's diseases, stroke, burns, heart diseases, diabetes, osteoarthritis, and rheumatoid arthritis.[4]

Recently, scientists have started to search applications of stem cells for the regeneration and repair of dentofacial and dental structures.[5,6]

At present, teeth can only be replaced with prostheses, i.e., removable prostheses, fixed prostheses, or implants, with prior bone augmentation if necessary. Stem cell biology and tissue engineering may present new options for replacing damaged or lost teeth, or even individual tooth structures. The promise of such treatment possibilities puts stem cells in the focus of dental research.[7]

2. Dental stem cells

Existence of stem cells in the teeth is an oaken phenomenon and is required for odontogenesis. In the early fetal developmental stages, teeth arise from the neural crest cells through a series of interactions between neural, mesenchymal, and epithelial tissues.[8] The developed tooth can be thought of as an encapsulated population of quiescent stem cells.[9] The finding of stem cells in natal teeth,[10] supernumerary teeth,[11] and odontoma[12] reinforces the concept that stem cells play a key role in the formation of every tooth. It has also been shown that the pluripotency of dental stem cells may be a function of the age of the tooth or the age of the donor. It means, the younger the tooth, the more is the number of dental stem cells.[13] In other words, primary teeth, molars, and wisdom teeth of young adults all contain potent sources of dental stem cells.

3. Dental sources of adult stem cells[14,15] (Fig. 1 and Table 1)

They are divided into two groups with respect to their major differentiation potential.

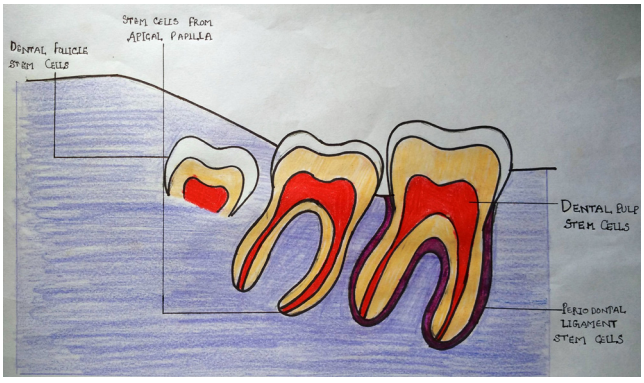

Fig. 1 – Dental stem cells.

1. First group is associated with the **dental pulp**
   a) Dental pulp stem cells (DPSC)
   b) Stem cells from human exfoliated deciduous teeth (SHED)
   c) Stem cells from root apical papilla (SCAP)
2. Second group is related to the **periodontium**
   a) Periodontal ligament stem cells (PDLSC)
   b) Dental follicle progenitor cells (DFPC)

4. Uses of stem cells in dentistry

1. Regeneration of dental hard tissues
   i. Enamel regeneration
   ii. Dentin regeneration
2. Regeneration of dental soft tissues
   i. Pulp regeneration
   ii. Periodontal tissue regeneration
3. Whole tooth regeneration

5. Regeneration of dental hard tissues

5.1. *Enamel regeneration*

Dental enamel is the hardest tissue of the body. Regeneration of enamel is dependent on ameloblasts, which are lost as soon as the tooth erupts in the mouth. The enamel spends the remainder of its lifetime vulnerable to wear, damage and decay.

Although researches have shown positive results in producing enamel-like and tooth-like tissues, still there are problems, which remain to be solved before the technology can be tested in humans. One of the major problems has been to produce a sufficient number of enamel-forming cells in culture. There have been reports that a new technique is being developed for culturing cells that have the capacity to produce enamel.[16]

5.2. *Dentin regeneration*

In response to any injury or trauma, dental pulp tissue has the regenerative potential to form dentin, which is known as the reparative dentin. Dentin formation was observed in immunocompromised mice when pulp stem cells were cultivated with hydroxyapatite or tricalcium phosphate scaffold and implanted in them. Reparative dentin was formed when stem cells were combined with recombinant human bone morphogenetic protein-2 (BMP-2) on adulterated pulp in experimental studies on animal models.[17]

6. Regeneration of dental soft tissues

6.1. *Regeneration of pulp*

Regenerative pulp procedures are biologically based procedures, which are designed to replace mutilated structures including dentin and root structures, as well as the cells of the pulp-dentin complex.

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