

# HUMAN DENTAL PULP STEM CELLS AND ITS APPLICATIONS IN DENTISTRY- A REVIEW

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## ABSTRACT

Stem cells are special human cells that can develop into any cell type of the organism if it's induced and have the ability to renew themselves under suitable conditions. Applications of stem cells exist in many fields. A Review study is conducted to analyze and investigate dental Pulp stem cells and its application. Human pluripotent stem cells (either human embryonic stem cells or induced pluripotent stem cells) can differentiate into every cell type of the human body with infinite self-renewal capacity. Hence, pluripotent stem cells are an ideal source to generate specialized cell types for cell replacement therapy, e.g. beta cells for diabetics. Nevertheless, due to a large number of differentiation steps, current protocols for *in vitro* cell differentiation are rather complex. To regulate the cell growth and differentiation, almost 20 signaling proteins and small molecules last for more than four weeks. Not all cells differentiate into the targeted cells but take incorrect differentiation paths during this multistep process. This can lead to a highly heterogeneous cell population with beta cells that are not fully functional. This paper reviews the recent studies and researches about dental pulp stem cells and their applications in the field of dentistry.

**KEYWORDS:** Dental pulp; pluripotent; regeneration; stem cells; stem cell therapy.

## INTRODUCTION :

Stem cells are of many types depending on their origin. Dental pulp stem cells are commonly referred to as mesenchymal stem cells (MSCs) derived from various components of tooth tissue, such as dental follicles or papillae, with multilineage differentiation and are capable of self-renewal under suitable circumstances to maintain or develop oral tissues. (Lakshmi, Ezhilarasan, Vijayaragavan, *et al.*, 2017). These cells can differentiate into odontoblast, adipocytes, cementoblast - like cells, osteoblasts, and chondroblasts and form dental and Pulp. (Sadaghiani *et al.*, 2016) DPSC can be obtained from postnatal teeth, wisdom teeth, and deciduous teeth. Using DPSC will prevent basic problems such as immune rejection, ethical conflict, etc (Perumalsamy *et al.*, 2018). Over 40 years adult stem cells have been used in clinical therapies. DPSC has a strong differentiation capability and the ability to regenerate a dentin-pulp Complex. (Cheng, 2003) Dental pulp stem cells (DPSC) derive from a cranial neural crest lineage, hold a stimulating propensity for neuronal differentiation, and additionally express multiple factors that are suitable for neuronal and axonal regeneration. (Mehta *et al.*, 2019) Tissue engineering applications using dental stem cells which can facilitate more rapid healing of oral wounds and ulcers,

even since gene transfer methods to regulate salivary proteins and oral microbial colonization patterns are promising and possible. (Lakshmi, Ezhilarasan, Nagaich, *et al.*, 2017)

This study reviews about the dental pulp stem cells and their applications in dentistry.

### **MATERIALS AND METHODS :**

This review study summarized the uses and applications of the DPSC in the dental industry from various research and review articles. The information was collected from search engines like Pubmed, BASE, CORE, Elsevier, science.gov and so on

Inclusion Criteria: Articles related to

- Human dental pulp stem cells
  - stem cells use and its applications
- The functional role of stem cells in dentistry.

Exclusion Criteria: Articles related to

- Blood cells
- Relation of other cells

Duration Considered for the selection of articles 2010 - 2020. Ten years of articles about Dental pulp stem cells considered for the study. Articles selected are well analyzed for the quality of the study and rechecked.

### **DISCUSSION:**

The detailed study about stem cells has a major effect on many research and can incredibly increase knowledge and awareness about stem cells.

#### **Human Dental pulp stem cells :**

Human dental pulp stem cells are present in the dental pulp, which is the soft living tissue within the teeth(Ezhilarasan, 2018).They are pluripotent, and it can be embryoid like structures in vitro and teratoma like - structures that contain tissues derived from all three embryonic germ layers when injected in mice(Alleman *et al.*, 2013). Human dental stem cells have been validated for osteogenic, chondrogenic, and adipogenic differentiation using our MSC differentiation media (Ezhilarasan, Sokal and Najimi, 2018). They exhibit self- renewal and multi-lineage differentiation capacity.

#### **Stem cells application in different fields :**

Stem cells Can be isolated from certain parts of body tissues(Liu *et al.*, 2007). For example, the umbilical cord is unique, young, potent, and it's more viable. Stem cell therapy provides great potential to control life-threatening diseases for over 55 years.(Gheena and Ezhilarasan, 2019) Stem cell therapy provides great potential for disease control. (Ashwini and Anitha, 2017). Various fields in medical & dental health care, have been using stem cells for culture, regeneration, and more. Stem cells can be used to grow new types of cells in a laboratory setting to replace the old damaged cells or organs or tissues.(Giovanni *et al.*, 2011) It is also used to correct the organ parts that do not work properly. Stem cells are widely used to test new drugs for its safety and effectiveness.

#### **DPSC Application in dentistry:**

Dental stem cells are the most accessible stem cells in the human body. (Ashwini, Ezhilarasan and Anitha, 2017). They are isolated from the healthy teeth's dental pulp, both primary and permanent teeth, the periodontal ligament, including the apical region of developing teeth, and other tooth structure (Yang *et al.*, 2015). Adult stem cells recently identified in gingival connective tissues (gingival mesenchymal stem cells [GMSC's]) have osteogenic potential and are capable of bone regeneration in mandibular defects. (Menon *et al.*, 2018) GMSC's also suppressed the inflammatory response by inhibiting lymphocyte proliferation and inflammatory cytokines and by promoting the recruitment of regulatory t-

cells and anti-inflammatory cytokines. Thus, GMSC's potentially promote the "right" environment for osseous regeneration and are currently under therapy. (Lakshmi *et al.*, 2015)

### **Dental pulp stem cells in Regenerative Medicine:**

Mesenchymal stem cells (MSC 's) can be quickly collected from the adipose tissue, so they have become a popular choice for tissue regeneration. Stem cells can differentiate into the other types of the cell as well as ectoderm, mesoderm, and endoderm, and used according to its regenerative purposes. (Waddington *et al.*, 2009) After many studies based on regeneration were going on, the stem cell use in regenerative medicine is incredible.(Karthiga, Rajeshkumar and Annadurai, 2018). Stem cell research paved the way for the development of many drugs which are used to identify drug targets and test potential therapeutics and to perform toxicity testing. (Mina and Braut, 2004). Stem cells are used for many diseases and used to transplant the old cells with newly produced cells. For example, bone marrow transplantation for leukemia and chemotherapy, nerve cells transplantation for parkinson and alzheimer's disease, heart muscle cells transplantation for many heart diseases, pancreatic islet cells transplantation for diabetes mellitus. (Lee *et al.*, 2012)

### **Future in DPSC :**

Dental pulp stem cells have shown great potentiality to be used in regenerative medicine for the treatment of various human diseases including dental-related problems (Rajeshkumar, 2018). The stem cell-based tissue engineering approaches are widely used to establish functional organs & tissue groups. Making a whole artificial tooth and periodontal framework by this technology is a challenge for dental regenerative therapists and scientists. (Eve *et al.*, 2008) Many types of research and experts expect every seventh person up to the age of 70 will need stem cell-based therapy, especially by DPSC to regenerate sick or aged cells and tissues. According to the researcher, the future of stem cell therapy and application will be incredibly amazing. (Rajeshkumar *et al.*, 2018) Researchers have found positive outcomes in several preclinical animal studies and numerous clinical trials are now ongoing worldwide to further validate these findings(Renuka and Sethu, 2015). The researcher has been effective in producing real dental tissue or masses, while in animal Studies in dental stem cell research will be the regeneration of functional teeth in humans.

### **CONCLUSION:**

Dental stem cells have multiple applications, with some limitations as well. The study examined the DPSC and its applications in dentistry. Future research development can lead to better knowledge about stem cells and to a better prognosis of any disease, which can be treated with stem cells in health care units can lead to a better life.

### **AUTHOR CONTRIBUTION:**

The authors have carried out the study by collecting data from search engines and drafted the manuscript by necessary information.They have Aided in conception of the topic, has participated in the review and has supervised in preparation of manuscript. The authors have participated in the study design and have coordinated in developing the manuscript. All authors have discussed the study details among themselves and contribute to the final manuscript.

**CONFLICT OF INTEREST:** None to declare.

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