DENTAL STEM CELLS: A LITERATURE REVIEW

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INTRODUCTION & OBJECTIVES

Stem cells are unspecialized cells capable of continuous self-renewal and to differentiate into a variety of mature cell types (Fig.1) when exposed to specific environments and stimulus. Thus, innumerous investigators have been studying their mechanism of differentiation in order to use them to regenerate damaged tissues, contributing to homeostasis, and improving the prognosis of some diseases. Stem cells can be isolated during the embryogenesis or collected from adult tissues, such as the bone marrow however, dental stem cells represent a good alternative since they are easy to obtain and present ability to differentiate into various types of specialized cells. In this study, we will focus on tooth derived stem cells, their characterization and clinical application, specially in regenerative endodontics.

MATERIAL AND METHODS

This literature review was carried in the **PubMed** database, using the combination of the terms **"stem cells"** and **"regenerative endodontics"** with the boolean conector **"AND"**. 14 relevant studies were selected, complemented with **4 crossed references**, making a total of 18 bibliografic sources.

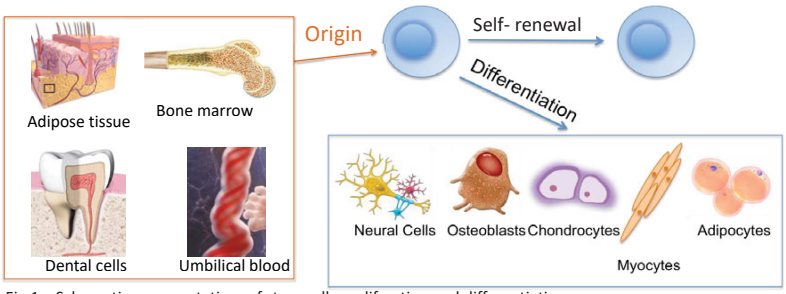

Fig.1 – Schematic representatiom of stem cells proliferation and differentiation.

RESULTS AND DISCUSSION

Dental tissues are an easily available source of stem cells, specifically the mesenchymal type, from which they can be obtained with low morbidity and with no additional risks for the donator, for example through the collecting of exfoliated/extracted teeth. However, they present as a limitation the small quantities of stem cells available from these teeth, specially at the time of the regenerative procedure. Until now, there have been already identified 6 types of tooth derived stem cells (TDCSs) considering their origin and location (Fig.2; Table 1).

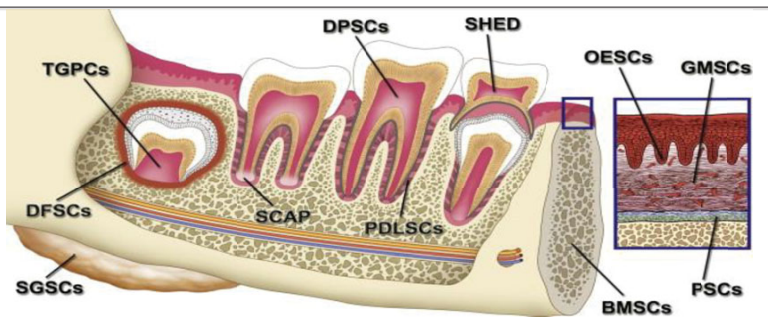

Fig. 2 – Schematic representation of sources of adult stem cells in the oral environment. – Adapted from: Anibal Diogenes, Michael A. Henry, Fabricio B. Teixeira & Kenneth M. Hargreaves (2013) An update on clinical regenerative endodontics. *Endodontic Topics,* **28**: 2–23

TDSCs	LOCATION	EXPRESSION MARKERS		DIFFERENTIATION CAPACITY	
		Positive	Negative	*In vitro*	*In vivo*
Dental Pulp Stem Cells (DPSCs)	Permanent tooth pulp	CD29, CD44, CD73, CD90, CD105, CD146, STRO-1, Oct-3/4, Sox-2, nanog	CD14, CD34, CD45	Osteoblast, adipocyte, chondrocyte, hepatocyte, neuron	Dentin-like structures
Stem Cells from Human Exfoliated Deciduous Teeth (SHEDs)	Deciduous tooth pulp	CD29, CD105, CD146, STRO-1	CD31, CD34	Osteoblast, odontoblast, adipocyte, neural cell	Dentin formation, induce bone formation by murine host cells.
Stem Cells from the Apical Papilla (SCAPs)	Apical papilla of developing tooth	CD24, CD29, CD31, CD44, CD73, CD90, CD105, CD106, CD146, CD166, STRO-1, Oct-3/4, Sox-2, nanog, survivin	CD14, CD18, CD34, CD45, CD150	Osteoblast, adipocyte, chondrocyte, hepatocyte, neuron	Dentin-like tissue
Dental Follicule Stem Cells (DFSCs)	Dental follicule of developing tooth	CD29, CD44, CD73, CD90, CD105, nestin	CD14, CD31, CD34, CD45, CD117	Osteoblast, adipocyte, chondrocyte, hepatocyte, neuron	Bone/cementum-like tissue
Periodontal Ligament Stem Cells (PDLSCs)	Permanent tooth periodontal ligament	CD44, CD90, CD105, CD166, CD146, STRO-1, Oct-3/4, Sox-2, nanog, nestin	CD14, CD34, CD45	Osteoblast/ cementoblast,adipocyte, neuron	Periodontal ligament/ cementum-like tissue
• **Periodontal Ligament Stem Cells from Deciduous Teeth** (DePDL)	Deciduous tooth periodontal ligament	CD105, CD166, STRO-1, Oct-4	CD34, CD45	Osteoblast, adipocyte	

Table 1 - Characterization of tooth-derived stem cells - Adapted from: Saito M.T., Silvério K. G., Casati M. Z., Sallum E. A., Nociti F. H. (2015) Tooth-derived stem cells: Update and perspectives. *World Journal of Stem Cells.* **7:** 399-407

When it comes to applying these cells in endodontic treatments, there may be an association between regenerative endodontics and tissue engineering, which is a multidisciplinary research area with the ultimate goal of restoring, maintaining, and regenerating damaged/lost tissue, based on the association of 3 intervenients: scaffold, signaling molecules and stem cells. The tissue-engineering in endodontics will allow us to achieve dentin/pulp regeneration through biological approaches. We have, so far, two major mechanisms in tissue engineering, regarding endodontics: cell homing and cell transplantation.

- ***Cell homing*** - regenerative procedure that consists in a cell-free method of regeneration of the pulpo-dentin complex. This process induces the recruitment of MSCs from the periapical area into de root canal and is stimulated by the colocation of growing factors and a scaffold in the place where we want regeneration.
- ***Cell transplantation*** - regenerative procedure, alternative to cell homing, that consists in a c*ell-based* approach of regeneration of the pulpo-dentin complex. This mechanism implicates the implantation of autologous or alogenous stem cells directly into the root canal sistem in order to occur regeneretion.

CONCLUSION

Tissue engineering of the dental pulp is a promising field that can potentially bring great benefits when it comes to oral health. However, there are still missing the necessary methods for the isolation and treatment of the stem cells as well as more studies mattering the best scaffolds to use in these procedures. Collectively, future research prospects in regenerative endodontics depend on the multidisciplinary cooperation of clinicians, scientists, engineers and their joint contributions to the development of techniques that help reestablishing the tooth vitality.

REFERENCES

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