



*In the Name of Allah the
Most Gracious and the Most
Merciful*

Isolation of Dental Pulp Stem Cells and their Ex Vivo Differentiation into Odontoblasts

THESIS

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By

Nermeen Elmotaz Bellah Ahmed, B.D.S. (2002)

Assistant Researcher (Oro-dental Genetics Department)

National Research Center

Supervisors

Prof. Dr. Siza Yacoub Zakhary

Professor of Endodontics

Department of Endodontics

Faculty of Oral and Dental Medicine

Cairo University

Prof. Dr. Eman Hassan Anwar Aboul-Ezz

Professor and head of Oro-Dental Research Division

National Research Center

*To my beloved mom and dad,
For you being the light of my life,
My heart and soul,
From you I get my strength and belief,
Thank you for everything,
You are my all*

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List of Abbreviations

BM:	Basement membrane
BMP:	Bone morphogenic protein
BMSSC:	Bone marrow stromal stem cells
β actin:	Beta actin
CD:	Clusters of differentiation
cDNA:	Complementary Deoxyribonucleic acid
DEJ:	Dentino-enamel junction
DEPC:	Diethyl procarbonate
DMEM:	Dulbecco modified eagle's media
DNA	Deoxyribonucleic acid
DP:	Dental papilla
DPSC:	Dental pulp stem cell
DSPP:	Dentin sialophosphoprotein
EBM-2:	Endothelial basal cell medium-2
ECM:	Extracellular matrix
EDTA:	Ethylenediamine tetraacetic acid
ESC:	Embryonic stem cell
FACS:	Florescence-activated cell sorting
FBS:	Fetal bovine serum
GAG:	Glycosaminoglycans
Gdf:	Growth differentiation factor
GFAP:	Glial fibrillary acid protein
HEPS:	1-(2-Hydroxyethyl)-1 piperazineethanesulfonic acid buffer solution
HSC:	Hematopoietic stem cell
IDE:	Inner dental epithelium

MACS:	Magnetic-activated cell sorting
MC:	Mesenchymal cell
MgCl₂:	Magnesium chloride
mRNA:	Messenger ribonucleic acid
MSC:	Mesenchymal stem cell
PBS:	Phosphate buffered solution
PCR:	Polymerase chain reaction
PDL:	Periodontal ligament
PDLSC:	Periodontal ligament stem cell
PI:	Propidium iodide
PPARY2:	Peroxisome proliferating activated receptor gamma 2
rh-BMP2:	Recombinant human bone morphogenic protein 2
rh-EGF:	Recombinant human epidermal growth factor
rh-IGF-1:	Recombinant human insulin growth factor-1
RNA:	Ribonucleic acid
Rt-PCR:	Reverse transcriptase polymerase chain reaction
SCAP:	Stem cells from root apical papilla
SHED:	Stem cells from human exfoliated deciduous teeth
SP:	Side population
STAT3:	Signal transducer and activator of transcription 3
TGF:	Transforming growth factor
UV:	Ultraviolet
VCAM-1:	Vascular adhesion molecule-1
VEGF:	Vascular endothelial growth factor

Introduction

Despite our extensive knowledge regarding the pathology of dental disease, restoration of diseased dental tissue to date remains fairly empirical. However, our increasing understanding of the exquisite regenerative potential of the dentine- pulp complex highlights the importance of characterizing fully the cellular and molecular processes under-pining dentin regeneration.

Pulpal exposure, due to caries shows very limited potential for pulp recovery due to bacterial infection of the pulp for substantial period of time, which compromises the defense reaction.

Vital pulp therapy aims to treat reversible pulpal injury and maintain pulp vitality and function. It includes two therapeutic approaches: indirect pulp capping in cases of deep dentinal cavities and direct pulp capping in cases of pulp exposures. Successful outcome for vital pulp therapy is very dependent on the type and location of injury, age of the tooth, treatment modality (capping material) and integrity of the cavity restoration.

Whilst the biological processes directed by the treatment strategy have received much attention, controversy still exists regarding the biological basis of the mechanism by which the capping material regulates healing and repair of the pulp in vital pulp therapy. Even if reparative dentin is formed, its orientation