Investigating the Role of Canonical Wnt Signalling in Dental Regeneration as Aided by FGF-2 (With Some Applications to Cancer Treatment)

Lilian Amer

Massachusetts Academy of Math and Science at the Worcester Polytechnic Institute

Advanced STEM with Scientific and Technical Writing

Instructor: Kevin Crowthers, Ph.D.

Worcester, MA. 01605

Abstract

Regeneration, the process of restoring damaged tissues, is a fast growing solution to various diseases in the medical field. However, natural human regenerative capabilities are limited in organs such as teeth, where pulp necrosis poses significant health challenges, affecting an estimated 2.44 billion people globally ("Global Oral Health Status Report towards Universal Health Coverage for Oral Health by 2030," 2022). Current treatments, including dental implants, carry risks such as peri-implantitis and jaw bone resorption, making them unsuitable solutions to most patients in the long run (Angelova Volponi et al., 2018).

As the field of molecular biology began to advance towards the end of the 20th century, researchers became interested in the canonical Wnt signalling pathway for its innate ability to differentiate and proliferate stem cells (Kellenberger, 2004). The aim of this study was to investigate how the modulation of the canonical Wnt signalling pathway using a combination of lithium chloride (LiCl) and basic fibroblast growth factors (bFGF) can influence stem cell behaviour in a Schmidtea mediterranea model. Results demonstrated that combining LiCl and bFGF enhanced regeneration rates and odontoblast-like differentiation, offering a minimally invasive solution for dental pulp regeneration. These findings provide a foundation for advancing regenerative therapies in dentistry and highlight broader applications in tissue engineering and cancer treatment.

Keywords: Wnt signalling pathway, dental pulp, stem cells, lithium chloride, basic fibroblast growth factor (bFGF)

Acknowledgements

I would like to thank Dr. Kevin Crowthers for his guidance and support throughout this project, as well as my parents for their constant emotional encouragement. I am also grateful to the teachers and peers at MAMS for their invaluable feedback and support, which have all played a crucial role in the completion of this work.