

Investigating the Effects of Time-Mediated Addition of Titanium Dioxide Nanoparticles on the Differentiation and Proliferation of Human Dental Pulp Stem Cells

Abstract

Dental pulp stem cells (DPSCs) have therapeutic promise due to their rapid proliferation and multipotency but require further research to reach their full potential. Titanium dioxide nanoparticles (TiO₂ NPs) possess properties for cell tracking and imaging, but their harmful effects on cell viability and function pose roadblocks to their usage. This study aims to investigate the timing of TiO₂ NP addition to DPSCs, a commonly neglected variable when testing NP toxicity, and its effects on DPSC proliferation and differentiation. Based on preliminary testing, DPSCs can respond to polybutadiene substrate mechanics after a 4-day incubation period. Accordingly, TiO₂ NPs will be added on both days 1 and 4 (NP-1 and NP-4, respectively) after plating DPSCs on hard polybutadiene films. Through the lens of mechanical properties, this study will explore the influence of time-mediated TiO₂ NP addition and examine its effects on DPSC viability, proliferation, and differentiation before and after recognition of polybutadiene-coated substrate. Results are expected to show that NP-4 had substantially reduced harm to DPSC proliferation and differentiation as compared to NP-1, which will suggest that time-mediated addition can prevent adverse effects of TiO₂ and NPs as a whole. These results can be translated to many other applications including drug delivery, developmental biology, biosensing, and biological imaging.