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Abstract

Creation of a Drug Delivery Mechanism for Dexamethasone Differentiation of Dental Pulp Stem Cells

As the life expectancy of humans continues to rise, age dependent ailments, such as osteoporosis and osteoarthritis, are becoming of greater medical concern. This study aimed to address an aspect of this problem by designing and testing a biomaterial scaffold that releases dexamethasone, an osteogenic inducing drug, to stem cells sitting on its surface to produce osteoblasts used for bone regeneration. Polyurethane and poly-L-D-lactic acid (PLDLA) scaffolds were synthesized and incorporated with Pluronic® F-127 (PF127) and gelatin hydrogels to create a drug delivering mechanism. Hydrogels were loaded with dexamethasone and tested for dexamethasone release rates with UV visible spectrophotometry and scaffolds were tested for hydrogel absorptivity rates by measuring change of mass. Dental pulp stem cells were plated onto the combined scaffold and hydrogel mechanism and observed under confocal microscopy to determine cell compatibility with the mechanism. Results indicated that the drug release rate of the hydrogels can be controlled for dexamethasone, and that hydrogels can be successfully integrated into biomaterial scaffolds to synthesize the drug releasing mechanism. However, rapid dissolution of the hydrogel in cell media suggests that a cross-linker is necessary for stronger attachment of the hydrogel to the scaffold to improve cell compatibility. The creation of a drug delivery mechanism that hosts and differentiates stem cells would lead to improved methods of bone regeneration by eliminating the necessity to differentiate stem cells prior to plating them on the scaffold.