Polymeric Scaffolds for Bone Tissue Regeneration

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ABSTRACT

Most bone graft procedures are implemented to repair bone defects stemming from injury or disease. Despite the benefits of current treatment options, limitations such as immune rejection, complicated surgical procedures and limited volume of donor tissue have necessitated the pursuit of alternatives. Hydrogels are a key group of biomaterials, resembling natural living tissue more than any other class of synthetic biomaterials. While hydrogels allow diffusion of nutrients and cellular waste necessary for cell survival in tissue engineering applications, this property also hinders localised delivery of soluble factors to the encapsulated cells, as the gel networks are equally permeable to encapsulated drug. Hot melt extrusion (HME) was therefore utilised in this study to prepare a controlled release drug delivery device which can be embeded within a PEG based hydrogel for use as a biocompatible tissue engineering scaffold which aids in the regeneration of tissue. Dissolution results revealed that the release profiles of model drug are altered by the presence of fillers. The presence of fillers also allows tuning of degradation rates, providing possibilities for their use as implants, where the rate of degradation of the scaffold should occur at the rate of formation of the new tissue, such as in bone tissue engineering. The MTT cytotoxicity assay provided data on the metabolic activity of NIH/3T3 model cell line when directly exposed to the hydrogel samples. Cell viability remained above 80% for all samples when compared to untreated control cultures. Microscopic evaluation revealed that cell morphology also appeared normal for these test specimens after 24h exposure. Overall, results obtained revealed that hot melt extrusion can be used to prepare these extended release devices which can be embedded within biocompatible scaffolds, providing osteoinductive cues and encouraging new tissue formation.