Charged Modification of Hydrogel for Nerve Regeneration

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Natural and synthetic hydrogels have attracted much attention for nerve regeneration. Previous studies have shown that electrical charge has significant effect on stimulation of neurite outgrowth. In this work, incorporation of a positively charged monomer into the photocrosslinkable oligo(polyethylene glycol) fumarate (OPF) hydrogel has been investigated. We have evaluated the effect of localized positive charge on neurite outgrowth in culture with an objective that positively charged hydrogels ultimately can be used for stimulating *in vivo* nerve regeneration. The effect of charged modification has been also studied on mechanical properties and swelling ratio of these hydrogels. Our data indicated that with increasing charge density hydrogels swelling ratio increased in water, however it remained constant in PBS. We also demonstrated that compressive modulus and tensile strength of the hydrogels improved with incorporation of electrical charge into the hydrogels. Biodegradation of modified hydrogels was investigated in a series of biomimetic solutions. OPF hydrogels appeared to be more susceptible to oxidative degradation as opposed to the hydrolytic degradation in enzymes and acidic solution, and the degradation rate was correlated to the PEG molecular weight and charge density of the hydrogels. To investigate the effect of charge modification on nerve cell attachment and differentiation, dissociated dorsal root ganglion (DRG) cells were plated onto the modified and unmodified hydrogels surfaces. DRG cells attached and extended their neurites more readily on the surface of positively charged hydrogels as opposed to the unmodified hydrogels.

