Synthesizing and Characterizing Novel Gelatin and Pluronic F127 Hybrid Hydrogels as a Barrier Membrane for Guided Bone Regeneration Following Periodontitis

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Periodontitis is the inflammation of gingival tissue and the leading cause of tooth loss. To treat periodontitis, guided bone regeneration (GBR) uses a barrier membrane to separate gingival tissue from bone, allowing for osteoblast regeneration. However, current barriers are costly and possess poor mechanical strength. In this study, we synthesized novel gelatin and Pluronic® F127 hybrid hydrogels with improved mechanical strength and evaluated their performance in vitro as GBR barrier membranes. Rheological analysis revealed a five-fold increase in elastic modulus in the hybrid hydrogels compared to pure gelatin. We propose that this improved mechanical strength is attributed to three factors: 1) F127 packed into the gelatin mesh allows the network to resist deformation; 2) physical bonding between F127 hydrophilic PEO blocks and gelatin reinforces the mesh network; 3) F127 physical crosslinks formed due to entanglement of F127 hydrophobic PPO blocks further strengthen the gel. We used the rubber elasticity theory to model the hybrid gels and calculate gel mesh sizes. Confocal microscopy performed on hybrid gels plated with human dermal fibroblasts revealed significantly reduced cell attachment compared to pure gelatin. 3D reconstruction from confocal image data confirms that hybrid gels remained impermeable to cells. Our findings suggest that gelatin-F127 hybrid hydrogels are a promising GBR barrier membrane biomaterial for periodontitis treatment.