Characterization of Single lumen and Multi-channel Poly(-capro-lactone-fumarate)(PCLF) for Experimental Nerve and Spinal Cord Repair.

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Introduction: Different biodegradable polymers have been used to fabricate single lumen and multi-channel nerve conduits for experimental peripheral nerve and spinal cord repair. Multi-channel conduits have been shown to provide guidance for nerve regeneration, allow cell attachment, and local release of incorporated growth factors and drugs.[1] For potential clinical application, it is important that these conduits also be flexible, do not swell, and conserve their structural integrity through-out implantation. In addition, it is important that conduits be permeable in order to promote diffusion of essential growth supporting molecules.[2] Recently, a new biodegradable polymer, poly(-capro-lactone-fumarate) (PCLF)[3], has been synthesized that has the potential for use in nerve injury repair. In this study, we investigated the *in vitro* swelling, flexibility, and permeability of single lumen and multi-channel PCLF nerve conduits.

Methods: Single lumen and multiple channel conduits of PCLF were fabricated using an injection molding technique.[1] For analysis of *in vitro* swelling, conduits were incubated in phosphate buffered saline at 37° during a 12-week period. The mass swelling ratio was determined from the wet weight and residual dry weight of the conduits after different time-points following the formula: $(W_{wet}-W_{dry})/W_{dry}$. The change in tube dimensions was determined by measuring pictures of the transverse area of the conduits at each time point. The flexibility of the conduits was measured on a Dynamic Mechanical Analyzer (DMA, TA Instruments, New Castle, D.E.) using a three-point bending test. The stiffness of the conduits and the yield-points (angle at which the conduits began to deform) were obtained from these trials. Permeability of the PCLF films was tested in a two-chambered diffusion apparatus using fluorescein dextran.

Results/Discussion: PCLF conduits did not swell during the 12-week period (Fig. 1). There was also no change in the dimensions of the total cross-sectional lumen and walls of the conduits. (Fig. 2). Flexibility testing showed that PCLF conduits are highly flexible with an average *E* of .9 MPa. A study of permeability has shown that PCLF on its own is not permeable, but the addition of gelatin beads (70% weight fraction) increased the permeability significantly.

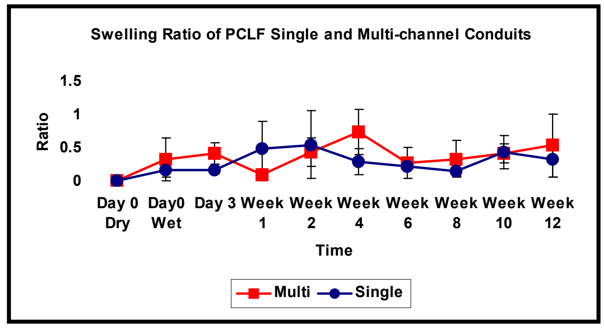

Fig 1: PCLF multi-channel (red) and single lumen (blue) conduits did not swell over a 12-week period.

Fig 2: Representative pictures of day 0 (left) and week 12 (right) PCLF multi- channel scaffolds.

Conclusion: In this study, the new biodegradable material PCLF showed that it possessed many attributes useful for the fabrication of multi-channel conduits that can be used in peripheral nerve and spinal cord repair. PCLF conduits did not swell and were highly flexible. They demonstrated an elastic deformation range on mechanical testing, and retained the ability to return to their original shape after three-point bending[3]. The addition of gelatin micro-spheres improved the permeability of the material. This property is important for controlled biomolecule delivery in nerve regeneration applications.

References:

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3. Jabarri, E. Biomacromolecules. 2005; 6:2503-11.

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