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In Vitro Neuron Interactions with Oriented Electrospun Fibres

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INTRODUCTION: Current electrospinning collection techniques typically result in random 'mats' of material [1], while for neural tissue engineering, orientated structures are of interest as guidance scaffolds [2]. Electrospun fibres have a high surface area to mass ratio; potentially providing significant surface-mediated signals for therapeutic cells while minimizing the quantity of degradation products. The ultimate aim is to orient, functionalize and determine their efficacy as a scaffold for neural tissue engineering.

METHODS: Poly(ε-caprolactone) (PCL) was dissolved in a mixture of chloroform and methanol (75/25 v./v.) to make a 9 wt% solution. The polymer solution was pumped to a 16-gauge, flat-tipped, stainless steel spinneret at a rate of 0.1 mL/h. Two stainless steel collection rings (35 mm OD, 25 mm ID) were positioned and a voltage of 15 or 25 kV was applied for 30 s to create an electric field of 1 or 1.67 kV/cm. The collected array of fibres was deposited on a glass slide and sputter-coated with gold. Telencephalon neurons were isolated from day 6/7 chick embryos and cultured on gold-coated electrospun fibres and slides in serum-free media for 8 days.

RESULTS: An array of electrospun fibres was collected between the dual ground rings after electrospinning (Fig. 1). Fibre splitting was controlled by voltage, with 15 kV producing single fibres with lengths of 8 cm and diameter of 1.26±0.19 μm and 30 kV resulted in web-like structures due to extreme fibre splitting (Fig. 2).

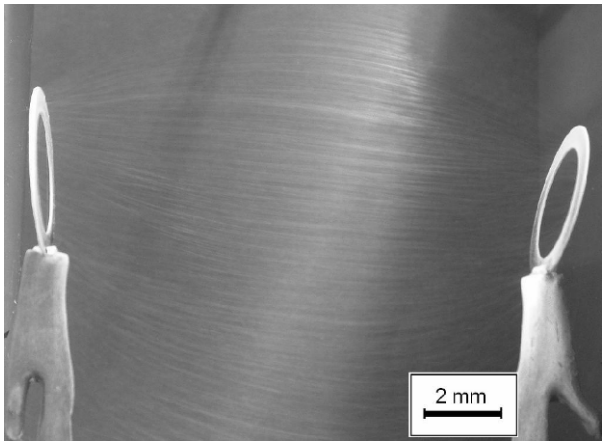

Fig. 1: An array of collected electrospun fibres.

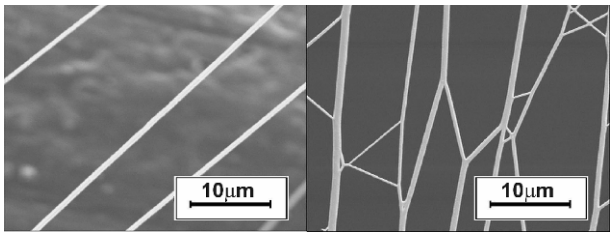

Fig. 2: Effect of voltage on electrospun fibres: 15 kV (left) and 25 kV (right).

As would be expected on gold surfaces, cell adhesion was poor; however neurites that extended from telencephalon neurons were influenced by the shape of the electrospun fibre, which is of similar dimensions to the neurite itself, and were guided along the length for some distances.

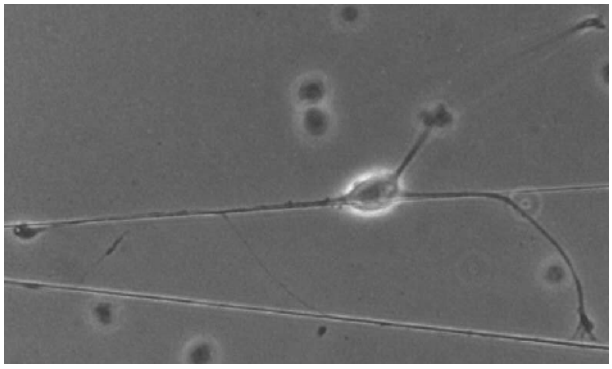

Fig. 3: A neuron after culturing on an electrospun fibre.

DISCUSSION & CONCLUSIONS: We have been able to produce an array of oriented electrospun fibres that are suspended between two collection plates. Lower voltages resulted in less fibre splitting and interconnectivity, with single electrospun fibres with lengths of up to 8 cm, and a diameter of 1.26±0.19 μm. These fibres, when placed upon flat surfaces, had a guiding effect on the extended neurites.

REFERENCES: [1] G. Verreck, I. Chun, & J. Rosenblatt *et al* (2003) *J Control Release* **92**:349-360. [2] C. E. Schmidt & J. B. Leach (2003) *Ann Rev Biomed Eng* **5**:293-347.

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