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The effects of polymer grade and sterilisation on electrospun fibre material properties and cell response

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INTRODUCTION:

Electrospinning biopolymers, such as poly(ϵ -caprolactone) (PCL), is a popular method for producing scaffolds that mimic the extracellular matrix of many tissues¹. Yet, research intended for overall translation to the clinic and human use requires various regulations to be adhered to, which includes material purity and recognised sterilisation processes. This study investigated the effects of polymer grade (chemical or medical) and sterilisation (ethanol or gamma) on the material properties and cell response of electrospun scaffolds.

METHODS:

Grades of PCL investigated: medical (Purac) and chemical grade (Sigma). Three-dimensional (3D) fibrous scaffolds were prepared as described in Bosworth *et al.*,¹. 3D scaffolds were sterilised in increasing concentrations of ethanol (50-100 %v/v) or gamma irradiated at 25 kGy (Synergy Health) prior to material characterisation, including tensile testing (Instron 1122, load cell 0.01 kN) and the morphology of seeded L929 fibroblasts (50,000 per cm²) was assessed up to 48 hours by Scanning Electron Microscopy (SEM). Data was not Normally distributed. A Kruskal-Wallis test with Dunns post-tests was used for comparison of data sets for each PCL grade and Mann-Whitney test for comparison of as-spun (dry) scaffolds.

RESULTS:

The results demonstrated a clear difference in tensile strength and stiffness depending on PCL grade, with statistical significance when comparing the as-spun (or dry) scaffolds (Fig.1). Fibroblasts attached to scaffolds irrespective of grade/sterilisation technique after 4 hours (Fig.2). By 48 hours, cells appeared flattened and spread-out on gamma irradiated scaffolds, whereas a rounder morphology was observed for cells seeded on ethanol sterilised fibres.

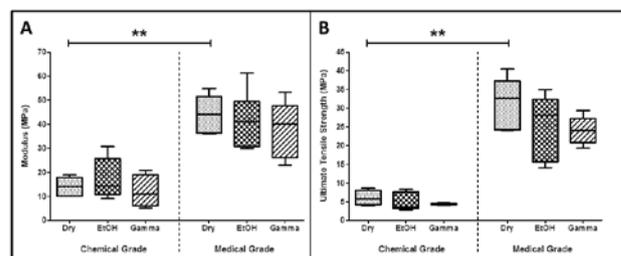


Fig. 1 – Tensile data comparing PCL grades and method of sterilisation for (A) Young's Modulus (MPa) and (B) Ultimate Tensile Strength (MPa). (n=5; p<0.01).

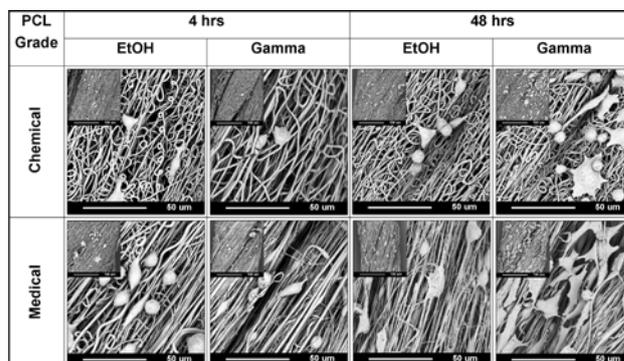


Fig.2 – SEM images demonstrating cell morphologies on PCL scaffolds. Scale bar = 50 μ m (inset 100 μ m).

DISCUSSION & CONCLUSIONS:

The data highlighted a significant difference in tensile properties depending on the material grade. Similarly, cell response appeared to be more favourable for cells cultured on gamma irradiated scaffolds. This study demonstrates the importance of incorporating the right materials and sterilisation processes early in the project timeline to aid translation to the clinic.

REFERENCES:

1. Bosworth *et al* (2013), *JMSMM* 24(6): 1605-1614.

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