Nerve Conduits For Nerve Regeneration: An In-Vitro Study Of Electrospun PLGA Nanofibers On Collagen


INTRODUCTION:
This study objective is to develop an aligned biocompatible cell-seeded PLGA on collagen mat as a nerve conduit for use in peripheral nerve regeneration. We will describe the method of constructing a tubular conduit from electrospun PLGA and the addition of collagen layer and human mesenchymal stem cells (hMSC) into this conduit. We aim to demonstrate that the constructed nerve conduit has the potential to substitute or replace existing commercial grafts in the future.

MATERIALS & METHODS:
Poly lactic-co-glycolic acid (PLGA) PL85GA15 was used with Dichloromethane (DCM) and Dimethylformamide (DMF) as solvents. We employed the electrospinning technique and controlled the fiber characteristic by altering the concentration of polymer, flow rate, voltage and distance from needle to collector plate to create aligned fibers. The optimal aligned fibers obtained was examined under scanning electron microscopy (SEM) for analysis of fiber morphology, average diameter and interfiber junction and tested for mechanical strength. The neural-differentiated human mesenchymal stem cell (hMSC) was seeded into the collagen-layered nanofibers and a biocompatibility assessment was done to assess the cell viability. Aligned electrospun PLGA on a collagen sheet was rolled into a tubular conduit and stabilised with a suture. The designed conduits were then seeded with hMSC and investigated with physical, mechanical and microscopic analyses and the degradation rate was measured.

RESULTS:
The electrospun fibres obtained were relatively aligned, with a smooth surface and no beads defects. The fibres had a diameter of average length of 0.96μm. The constructed aligned fibres were successfully seeded with skin fibroblasts cells as demonstrated by normal cell distribution under microscopic analysis. The live/dead staining of the skin fibroblasts cells seeded on electrospun nanofibres result showed no significant number of dead cells observed. The nerve conduits developed measured 40.0mm long conduit with an internal diameter of 2.0mm and thickness of 1.03mm. The degradation study of nerve conduit showed the PLGA fibres reached a plateau by 12 weeks and did not degrade further. Human MSCs were successfully induced into neural lineage for seeding into the constructed nerve conduit.

DISCUSSION:
The technique of nerve conduit construction using electrospun PLGA is relatively cheap and reproducible. Aligned fibres improve neurite