CNT-based Hybrid Materials as Nerve Guidance Conduits for Sciatic Nerve Regeneration

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The sciatic nerve is the longest and widest nerve fiber in the human body, responsible for supplying sensory and motor functions to the lower part of the body. Any injury to the nerve section or subsequently to the spinal cord can result in loss of the nerve functions [(1)]. Additionally, the formation of neuromas at the lesion site prevents regeneration of the nerve with current treatment being insufficient to regain proper former function [(2)]. Besides nerve transplant and grafting which pose great complications both to the host and the donor, nerve guidance conduits (NGCs) offer a good alternative for nerve regeneration. Current grafts, based on collagen, poly (lactic-co-glycolic acid) (PLGA) and self-assembling peptide amphiphiles (PA) fall short on mimicking the nerve properties [(3)].

Herein, we present CNT (Carbon Nanotubes) based scaffolds culminating in patentable biomaterials as conduits for nerve tissue regeneration. The hydrogels were synthesized and characterized to study the morphological, chemical, mechanical and electrical properties including rheology analysis, thermal gravimetric analysis (TGA), and sheet resistance. They exhibit a network of interconnected fibres engulfing MWCNT with pore size distribution >10 um allowing cell penetration. Scaffolds were then optimized for *in-vitro* studies with SH-SY5Y cells showing no cytotoxicity compared to 2D control and possibly favouring growth on CNT scaffolds. Finally, *in-vivo* studies on mouse models with sciatic nerve damage/injury (crush injury and total excision injury) showed better wound healing with CNT scaffolds compared to the control. All mice presented minimal signs of distress and all scaffolds were found to be biocompatible and non-toxic. CNT implants after 3 weeks showed positive nerve regeneration signs.

References

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Figures

Figure 1: Schematic representation of nerve guidance conduits based on CNT