MaRM / MICRA: **Regenerating cartilage using biomimetic composites**

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Outline:
The incidence of degenerative diseases, such as osteoarthritis, is increasing as a result of population ageing and rising obesity. These conditions have a profound negative effect on the quality of life of sufferers. Consequently, there is increased demand in the field of regenerative medicine to provide targeted strategies to restore quality of life and reduce the associated social and economic costs[1,2]. Biomaterial scaffolds fabricated from electrospun fibres or hydrogels are under investigation as implantable therapeutics due to their potential to replicate and temporarily restore the extracellular matrix (ECM) of the tissue requiring repair[3]. An engineered replica ECM provides functional stimuli to cells instigating normal cell behaviour and neotissue formation to promote regeneration. Despite a valid rationale and a significant volume of published research, few of these scaffolds actually translate into bedside solutions for clinical problems. This is due to inherent disadvantages of fibres (poor cell infiltration) and gels (weak mechanical strength) when used alone. This funding will investigate the combination of both techniques to create composite structures that more closely mimic the ECM, which itself is a composite structure of nanofibres within a gel-like matrix.

With no gold standard intervention for the treatment of patients suffering from osteoarthritis of the knee[4], despite a wide range of therapies being developed and trialled over the years, such as auto/allografts, direct cell implantation, mosaic-plasty, and biomaterial/tissue engineered approaches, there remains an unmet clinical need. Annually in the UK, approximately 10,000 patients require treatment to damaged cartilage tissue[5] and >70,000 patients undergo knee replacement surgery[6] that could otherwise benefit from regenerated cartilage. In England alone, 35% of people aged 65+ suffer from total osteoarthritis of the knee[7]. This project will specifically focus on development and characterisation of three-dimensional (3D) fibre-encapsulated composites targeted for cartilage repair.

This proposal introduces a new collaboration between the Universities of Manchester and Cambridge with the aim of undertaking three work packages: 3D composite manufacture, in vitro 3D cell culture and physical testing.

Expected outputs:
This project will establish a new inter-disciplinary collaboration between research groups at The University of Manchester and University of Cambridge. Completion of the work-plan will lead to an original research article ready for publication in a high impact journal with further dissemination at a UK conference. Collected data will further benefit Dr Bosworth's application for a career development fellowship and on-going collaborative partnership with Dr Oyen at Cambridge. In addition, this academic partnership will benefit Dr Oyen's research group with access to cell culture facilities, which will lead to further collaborative outputs from the two universities.

References:
[1]Regenerative medicine report. House of Lords, Science and Technology Committee, July 2013. [2]Taking stock of regenerative medicine in the United Kingdom. Department of Health, July 2011. [3]Bosworth LA, et al. Nanomedicine: Nanotechnology, Biology and Medicine. 2013, 9(3): 322-335. [4] Falah M, et al. International Orthopaedics. 2010, 35(5): 621-630. [5]Cartilage damage – NHS. http://www.nhs.uk/conditions/cartilage-damage/Pages/Introduction.aspx Accessed September 2015. [6]Knee replacements – NHS. http://www.nhs.uk/conditions/Knee-replacement/Pages/Kneereplacementexplained.aspx Accessed September 2015. [7]ARUK – data and statistics. https://www.arthritisresearchuk.org/arthritis-information/data-and-statistics/musculoskeletal-calculator/analysis.aspx?ConditionType=2&ChartType=1&Region-0=all&AgeBracket=3,4.