Engineering cells for orthopaedic therapy

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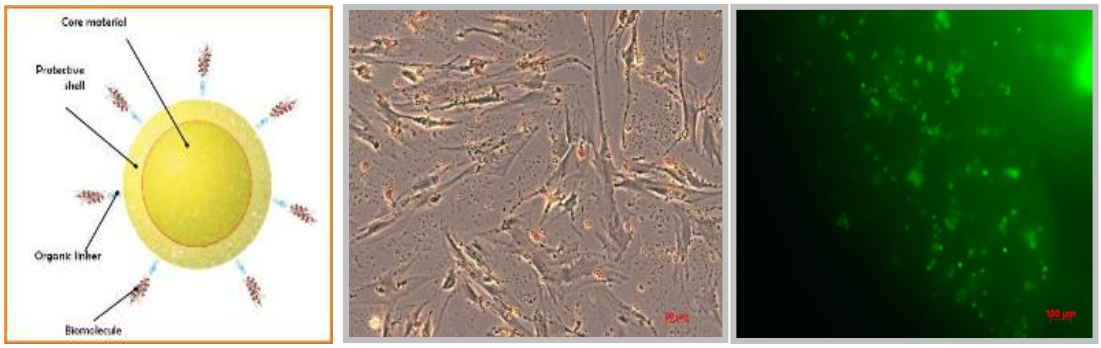
Abstract

Stem cell therapy is one of the most exciting and promising areas for disease treatment and reparative medicine. The demographic challenges of an advanced aged population need innovative approaches to augment and repair tissues which are failing or damaged. Whilst the last decade has seen a wealth of publications on materials, stem cell biology and growth factors, most of these strategies have failed to translate into routine clinical practice. There is clearly a need to address the bottlenecks in implementing cell therapies to bring these innovative treatments to practice.

One such bottleneck is the uncertainty which exists regarding controlling cell position and behaviour. There is conflict in the literature regarding the fate of stem cells once they have been delivered into the body. There is little information regarding the percentages of cells needed to deliver to the patient to initiate responses or repair due to an inability to track their migration and residency time. In addition, if the cells reach the site of repair, the next challenge is to control their phenotypic differentiation into the relevant tissues or to provide the paracrine responses which are required. A number of biomaterial with or without growth factor release strategies exist to address the question of cell control.



Our group has been considering the relationship between the cell and the surrounding physical environment; specifically the implications of this relationship for cell therapeutics. We have been addressing various protocols for translating cell biomechanics to the clinic. These methods have involved investigating the nature of the surrounding pericellular matrices around cells and the potential role in mechano-transduction. We have designed bioreactor growth environments which allow us to provide the appropriate mechanical cues relevant to the tissue under construction. Strategies have been developed for optimising matrix surface chemistry to improve mechanical signalling as well as enhancement strategies for releasing agonists to mechanotransduction pathways. Recently, we have been developing stem cell receptor targeting with magnetic nanoparticles, which allow us to control mechano-sensitive receptor opening and closing remotely using magnetic fields. In this way, we can investigate using magnetic strategies to target stem cells to regions of the body and then controlling their differentiation at the repair site. These studies will be outlined in the presentation alongside the potential applications in orthopaedic therapies.

Biography

Alicia El Haj is Professor of Cell Engineering and Director of the Institute of Science and Technology in Medicine at Keele which forms part of a new joint Medical School between Manchester and Keele University. She is involved in bringing together interdisciplinary groups within biomedicine, physical sciences and engineering interested in aspects of cell and tissue engineeri ng. The Institute, based at the North Staffordshire Hospital and the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry has rated highly through the past 3 RAEs and the research programme is at the clinical interface, with cell therapies in routine clinical practice for orthopaedic repair and leading MRC multi-centre funded trials. The Institute recently started an EPSRC Doctoral Training Centre in Regenerative Medicine. She has published over a 100 publications in the area of cell and tissue engineering with an emphasis on physical interactions with cells and new connective tissue repair strategies using novel enabling technology approaches with funding from the EPSRC, BBSRC, Wellcome and EU Framework.

Prof. El Haj is a member of the European council for TERMIS, the UK National Stem Cell Advisory Board, the IFMBE Working Group for Cellular Engineering, and the IPEM Academic Advisory board and has recently stepped down from President of the UK Tissue and Cell engineering Society. She has been a member of the EPSRC and BBSRC Funding and Advisory Panels, the MRC College of Experts and a panel member for the RAE 2008.