Acadamh Ríoga na hÉireann
Royal Irish Academy

Charlemont Grant Report

Recipient Name:	Dr Gayathri Kollamaram
Discipline:	Sciences
Amount and year awarded:	€1,850 in 2019
Title of Project:	3D-Bioprinting of scaffolds for osteochondral repair

Summary of findings:	Chondral and osteochondral lesions have debilitating effect on the joints and with a potential risk of them progressing to osteoarthritis, there is a need to develop techniques for an efficient treatment of these lesions. Autologous chondrocyte implantation (ACI) has been most widely used of the techniques used for treating large and full-thickness lesions, however, it is associated with complications such as donor-site morbidity, fibrotic hypertrophy and graft delamination. Matrix-induced autologous chondrocyte implantation (MACI) was developed as a third generation ACI technique to address the complications associated with the latter, where chondrocytes are cultured in a 3-dimensional collagen scaffold prior to the implantation. The promising clinical results from MACI, inspired the development of scaffolds from material that not only can promote osteochondral regeneration in the lesions but also maintain the biomechanical properties of the native tissue. Poly (ε-caprolactone) (PCL) is asynthetic bioresorbable polymer with proven success in tissue engineering applications for bone and cartilage repair using different rapid prototyping techniques. Our group has extensive experience in using collagen based scaffolds for various tissue engineering applications. The premise of successful application of collagen in MACI, and PCL for bone tissue engineering applications, inspired us to take advantage of properties of both the materials and fabricate PCL-collagen composite scaffolds mimicking the biomechanical properties of the native tissue. The objective of this research was to develop off-the-shelf scaffolds for cartilage repair including focal as well as large and full-thickness lesions. Plug and fleece approach is chosen for the fabrication of scaffolds, where the plugs act as conduits that assist the transfer of bone marrow derived stem cells (BMSC) from subchondral zone to the chondral zone, thereby eliminating the need for culturing the scaffolds with chondrocytes prior to their implantation and the fleece is used to cover the lesions. MEW technique developed by the host institute was used to fabricate composite scaffolds replicating the chondral region of an osteochondral scaffold. This is of great significance in developing a scaffold mimicking the properties of both, native cartilage and bone. TERG at RCSI has previously successfully developed scaffolds for chondral defects. The techniques learnt from the UMC Utrecht will enable the TERG group at RCSI to take our research a step ahead and develop composite scaffolds for osteochondral repair.
Plans for continuing collaboration:	I currently am no longer working at RCSI. However, the collaboration initiated with the aid of this grant is being carried forward by the TERG at RCSI.

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Publication plans:	The techniques developed during the research visit were translated to the TERG lab at RCSI and are being used by the members in the group which are yet to be evaluated and published.
International dissemination:	Research arising from the work done during the research visit has been presented at European Orthopaedic Research Society conference 2019-Maastricht, by the researchers in the group (as I have resigned at RCSI effective from the 14th of June 2019.)