European Cells and Materials Vol. 32. Suppl. 4, 2016 (page 135) ISSN 1473-2262

Mesenchymal stem cells osteogenic differentiation on 3D printed titanium scaffolds

S Samizadeh[1], C Liu[1]

[1] *John Scales centre for biomedical engineering, Institute of Orthopaedics and Musculoskeletal science, University College London, Royal National Orthopaedics Hospital, Stanmore, London*

INTRODUCTION: 3D scaffolds are increasingly used in orthopaedics and maxillofacial surgery to augment bone repair. The aim of this study was to test a 3D scaffold designed for use as bone anchor in rotator cuff repair. So far strategies for rotator cuff repair have not been effective enough in achieving long-term fixation and avoiding failure. The aim of this study is to evaluate the bioactivity of 3D printed titanium scaffolds *in vitro*. Hydroxyapatite is known to enhance bone formation on titanium scaffold[1]. Therefore, we hypothesize that 3D titanium scaffolds would allow more bone deposition within the scaffold hence encouraging better osteointegration of the scaffold. In addition nano sized HA coating of the titanium would further enhance bone deposition by bone marrow derived stem cells.

METHODS. 3D titanium scaffolds (n=3) with and without Hydroxyaptite (HA) coating with porous structures of 2x2 mm were seeded with 10,000 ovine bone marrow derive stem cells (BMSCs). Samples were incubated for 21 days in normal DMEM and osteogenic culture media. Alamar Blue, DNA quantification and ALP assay were used to confirm cell proliferation and osteogenic differentiation of the cells. Scanning Electron Microscopy (SEM) and immunohistochemistry using DAPI and phalloidin staining assessed cell attachment and morphology on the scaffolds.

RESULTS: The results of this study indicated cell attachment and proliferation on the surface of both coated and non-coated scaffolds (Fig 1.). HA coated scaffolds showed enhanced cell proliferation in comparison to non-coated scaffold. ALP assay confirmed the osteogenic differentiation of the seeded cells. Fluorescent imaging confirmed the attachment of the seeded cells on the surface of the scaffold.

DISCUSSION & CONCLUSIONS: 3D scaffolds have the potential to encourage bone formation as a function of their architectural design and material composition. In this study we showed that both HA coated and non-coated titanium scaffolds support bone marrow derived stem cells attachment, proliferation and osteoblastic differentiation *in vitro*. Study of bone formation within the scaffold core and on the periphery of scaffold when implanted *in vivo* would further prove the success of these designs in promotion of bone formation and augmentation of osteointegration and ultimately better fixation of rotator cuff anchors.

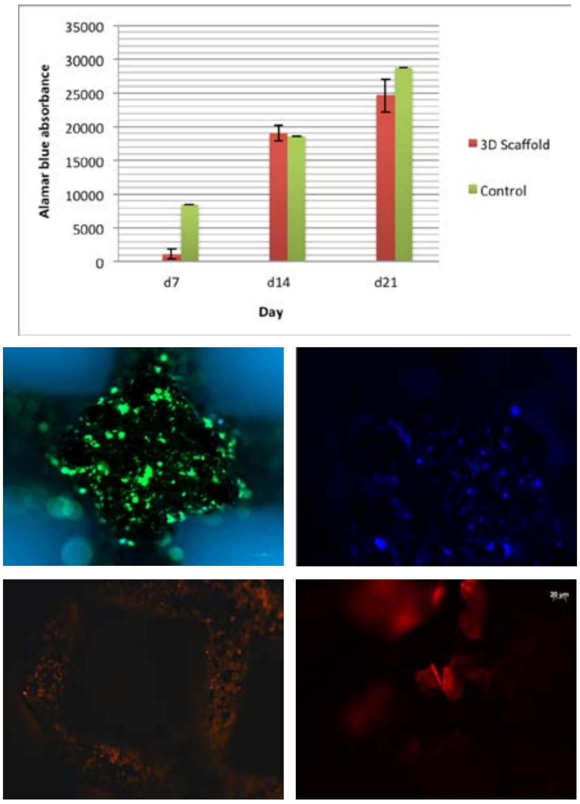

Fig. 1: Graph indicating alamar blue absorbance of bone marrow derived stem cells on the 3D scaffold within 21 days. Images indicating fluorescent-labelled cells on the surface of the scaffold. Blue: DAPI staining, Red and green phalloidin staining

REFERENCES: 1. Wang et al., 2014. Bonee tissue engineering via nanostructured calcium phosphate biomaterials and stem cells. Bone Research 2, Article number: 14017

ACKNOWLEDGEMENTS: MeDe innovation, the EPSRC centre for Innovative Manufacturing in Medical Devices kindly supported this study.