Aban Shuaib

Aban Shuaib (AS) is multi-disciplinary researcher with experience in *in vitro*, *in vivo* and *in silico* techniques. He is a part of the MultiSim project work-package 5, which focuses on modelling molecular and cellular events triggered when a cell is exposed to mechanical stimulation. Cell biology is his main field of interest with intracellular signalling and communication as the focus. He is interested in modelling cell signalling and its networks computationally and verifying these models experimentally. Aban also has expertise in agent based-modelling (ABM) paradigm, he uses his knowledge in this area to examine the emergent behaviour at the system level from interactions of its main constituents. Aban's PhD explored the effects of spatio-temporal regulatory elements on the activation dynamics of the mitogen activated protein kinase (MAPK) pathway and how oscillatory behaviour emerge in the system. He uses ABM to model mechanotransduction events and cell-cell interaction within bone tissue. He collaborates with researchers on other work packages on work involving connecting models at the molecular, cellular and tissue scales in bone tissue.

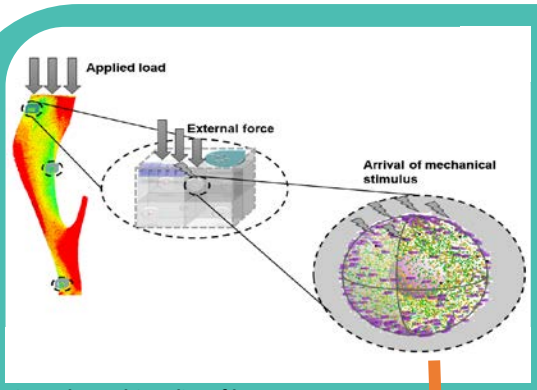

Fig 1: The multi-scality of bone

Bone physiology is the outcome of reciprocal interaction between entities at different scales (Fig 1). The tissue (such as the tibia) is subject to dynamic mechanical forces, which it transfers to the bone remodelling unit (BRU). BRU is comprised of cells and the extracellular matrix (ECM). The ECM propagates the mechanical stimulation to individual cells. The latter sense and respond to this stimulation. Their response modifies the ECM, which alters the mechanical properties of the BRU. As different BRUs are exposed to different mechanical environment, they differentially modify the tibia mechanical characteristics…

… My role in MultSim involves the development of computational model which simulate these described cell and molecular events in bone tissue. Additionally, it encompasses the integration of these models with the tissue scale. This involves simulating intracellular events in response to mechanical stimulation (Fig 2) …

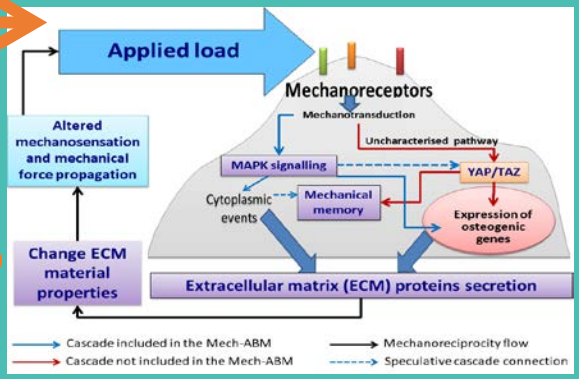

Fig 2: The principles of mechanotransduction and mechanoreciprocity

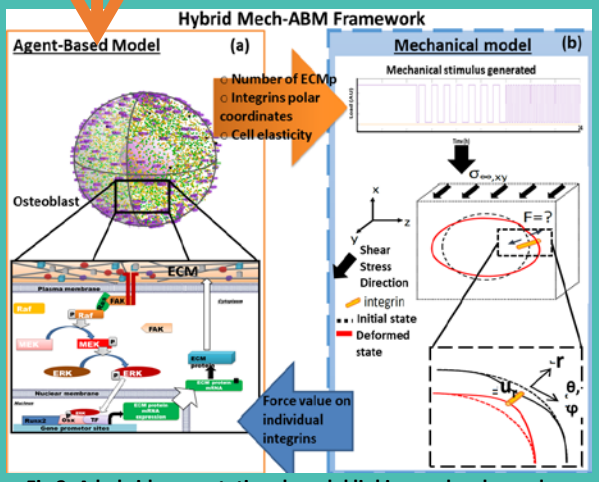

Fig 3: A hybrid computational model linking molecular and cellular events to the tissue scale.

… that induce osteogenesis. These lead to change in tissue material properties. My work resulted in the development of a computational model linking these scales (Fig 3).

I was also involved in leading a proof-of-concept project which expanded the capability of the model to find optimum bio-mechanical conditions to prevent osteoporosis and accelerate bone fracture healing.

INSIGNEO Institute for *in silico* Medicine
The University Of Sheffield.
Sheffield Teaching Hospitals NHS NHS Foundation Trust
EPSRC Engineering and Physical Sciences Research Council

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Publications

Shuaib, A., Motan, D., Bhattacharya, P., McNabb, A., Skerry, T. M., Lacroix, D. (In Submission), "Integrins Mechanical Properties Determines Mechotransduction Dynamics in Bone Osteoblasts", Scientific Reports.

Shuaib, A., Motan, D., Bhattacharya, P., McNabb, A., Skerry, T. M., Lacroix, D. (In Submission), "Exploring Integrins Mechanical Properties and influance on osteoblast mechanotransduction and Osteogenic gene expression using a hybrid model coupling a mechanical model and the agent based modeling formalism", Scientific Data.

Ascolani, G., Lacroix, D., Skerry, T. M., Dall'Ara E., Shuaib, A. (In Submission). "Revealing hidden information in osteoblast's mechanotransduction through analysis of time patterns of critical events using a mechanotransduction agent based model", BMC Bioinformatics.

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Other Achievements

Prizes and Awards:

Feb 2019: Awarded £400 Career Development Fund via the Medicine, Dentistry and Health Research Staff Association (MDHRSA) to visit future collaborators in McGill University (Montreal, Canada).

Oct 2018**:** Awarded Santander Research Mobility Awards £4000 to which I was the principle and sole applicant.

Sep 2018: Awarded travel bursary worth €300 by the organising committee of the 9th Berlin-Brandenburg School of Regenerative Therapies (BSRT, Berlin, DE) Symposium.

Apr 2017: Awarded a grant worth £40,000 to lead a proof-of-concept project as a PI. The grant was a competitive MultiSim scheme project.

Presentations and conferences:

Shuaib, A. (2019), "Searching For Mechanisms of Cellular Mechanical Memory", McGill University, Montreal, CA, 07 Feb 2019

Ascolani, G., Shuaib, A., Dall'Ara, E. (2018), "Formation of Temporal Patterns in the Osteoblast's Molecular Network", Complex Networks 2018 International Conference, Cambridge, UK, 11-13 Dec 2018

Shuaib, A., Ascolani, G., D., Skerry, T. M., Lacriox, D. (2018), "Searching For Mechanisms of Cellular Mechanical Memory", 9th BSRT Symposium, Berlin, DE, 28-30 November 2018

Shuaib, A., Ascolani, G., Bhattacharya, P., Beladaci, Y., Skerry, T. M., Lacroix, D. (2018), "Identifying Signalling Loci Involved in the Emergence of Mechanical Memory in Osteoblasts", BioMedEng18 Conference, London, UK, 06-07 Sept 2018

Shuaib, A., Motan, D., Bhattacharya, P., Skerry, T., Lacroix, D. (2018), "Interpretation of mechanical stimulus by osteoblasts dependence on combination of mechanosensitivity heterogeneity in integrin populations and mechanosensitivity threshold", 8th World Congress of Biomechanics (WCB2018), Dublin, IE, 08-12 Jul 2018

Shuaib, A., Ascolani, G., D., Skerry, T. M., Lacriox, D. (2017), "Integrin Mechanosensitivity and Population Heterogeneity Play a Role in Shaping the Mode of Mechanotransduction Events", 8th BSRT Symposium, Berlin, DE, 29 Nov - 01 Dec 2018

Shuaib, A., Motan, D., Skerry, T., Lacriox, D. (2017), "Spatiotemporal Modulation of Osteoblastic Integrin Receptors Influences Bone Tissue Remodelling", the 23rd Congress of the European Society of Biomechanics, Seville, ES, 02-05 Jul 2017