APCOM & ISCM
11-14th December, 2013, Singapore

# How coupling of bone cells in basic multicellular units shapes cortical bone porosities

***P.R. Buenzli[1], Peter Pivonka[2], and David W Smith[3]**

[1]School of Mathematical Sciences, Monash University, VIC 3800, Australia.
[2]Northwest Academic Centre, Australian Inst. Musculoskeletal Science, University of Melbourne, VIC 3021, Australia.
[3]Engineering Computational Biology Group, The University of Western Australia, WA 6009, Australia

*Corresponding author: pascal.buenzli.monash.apcom@gmail.com

Bone-resorbing cells (osteoclasts) and bone-forming cells (osteoblasts) communicate with each other through several signalling molecules to coordinate the bone remodelling process. This coupling results in the emergence of standalone groups of cells termed basic multicellular units (BMUs).

In this contribution, we propose a computational model of a single BMU to elucidate how cell number and cell activity shape the Haversian pores created by the passage of BMUs through bone. The model includes the embedment of osteocytes in bone matrix and the subsequent mineralisation of the matrix. The resorption depth, the thickness of the newly-deposited matrix and the zone of demarcation between nonmineralised and mineralised bone are followed in space and time and compared with tetracycline experimental data. Our model suggests that biochemical cell coupling enables newly-formed bone to effectively match the amount of resorbed bone even in transient developing states of the BMU, except in BMUs following pre-existing canals.

**Keywords:** Bone remodelling, basic multicellular unit, resorption cavity, cortical bone porosity