Stem cell treated osteogenesis imperfecta bone imaged using Raman spectroscopy

M. Hedegaard[1,2], K. L. Cloyd[1,2], M. Vanleene[2], P. V. Guillot[3], S. J. Shefelbine[2], M. M. Stevens[1,2]

[1] Department of Materials, Imperial College London, London SW7 2AZ, U.K.
[2] Department of Bioengineering, Imperial College London, London SW7 2AZ, U.K.
[3] Institute of Reproductive and Developmental Biology, Imperial College London, London W12 0NN, U.K.

Osteogenesis Imperfecta is a genetic disorder in which affected persons experience varying levels of bone fragility due to their inability to produce normal amounts and/or quality of type I collagen. Transplantation of healthy stem cells provides potential treatment options which have been previously suggested[1] however further research is needed to determine the interaction between the stem cells and the recipient. This study investigated Osteogenesis Imperfecta mice (oim), treated prenatally with human stem cells, using bio-Raman micro-spectroscopy to determine the biomolecular differences of the bone matrix between oim, oim with a stem cell treatment (oim+IUT), and wild type mice(WT)[2]. Raman spectra were taken from the cortical cross-sections of the mice femurs in a band of frequencies including the peaks attributed to apatite crystals and proteins associated with the bone mineral matrix. Further univariate and multivariate statistical analysis has been applied to extract information on the variances between experimental groups. Raman analysis shows distinct differences in the bone matrix between males and females receiving the same treatment. Oim in comparison to WT showed a higher mineral to protein ratio potentially attributed to a decrease in collagen content. Oim+IUT mice in comparison to oim displayed a higher carbonate to phosphate ratio and a possible increase in carbonate substitution in females and a sharper apatite peak in males suggesting a more crystalline matrix. These and other results from Raman analysis provide insight into how a stem cell treatment would affect the bone matrices of patients suffering from Osteogenesis Imperfecta.

References

[1] P.V. Guillot, O. Abass, J.H. Bassett, S.J. Shefelbine, G. Bou-Gharious, J. Chan, H. Kurata, G.R. Williams, J. Polak, N.M. Fisk. *Blood*. 111(3), 1717-1725 (2008).
[2] M. Vanleene, Z. Saldanha, K. Cloyd, G. Jell, G. Bou-Gharios, J.H. Duncan Bassett, G. Williams, N.M. Fisk, M.L. Oyen, M.M. Stevens, P.V. Guillot, S.J. Shefelbine. *Blood*. 117, 1053–1060 (2011).