STUDY OF APOE GENE DEFFICIENCY AND ITS EFFECT ON MOUSE BONE QUALITY USING micro-RAMAN SPECTROSCOPY

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Bone is a fibrous composite, consisting of carbonated apatite embedded in an organic collagen framework. Skeletal fractures can occur when the loads imparted to the bone exceed its mechanical resistance. «Bone quality» is a term often used to encompass bone structure (mass, geometry, architecture), material properties of the tissue itself such as mineral and collagen matrix composition, microdamage accumulation, collagen cross-linking, tissue hydration and even remodeling dynamics (bone turnover).

The scope of the current study was to investigate the role of APOE gene in bone quality. The main function of APOE is to participate in lipid metabolism and has a wider role in immunology and immunomodulation. For this purpose femoral and vertebrae from APOE deficient mice were compared to healthy controls.

Bone composition and quality was evaluated employing Raman spectroscopy, an analytical technique which is particularly suited to biomaterials since it enables the organic and mineral component to be studied simultaneously.

Several Raman spectra were acquired from the samples and the intensities of the primary phosphate band at 959 cm^{-1} and 1072 cm^{-1} for the carbonate of the mineral, the matrix bands at 855 cm^{-1} (proline), 877 cm^{-1} (hydroxyproline) and 922 cm^{-1} (proline), as well as the major sub-bands under amide I envelope (1590-1710 cm^{-1}) were measured.

The mineral to matrix ratio [959 cm^{-1} / (855 cm^{-1} + 877 cm^{-1} + 922 cm^{-1})] as well as mineral carbonation and crystallinity showed no statistically significant variation for the two groups. On the other hand, band ratio of 1660 cm^{-1} / 1690 cm^{-1} in the amide I spectral area was increased for the experimental group of gene deficiency compared to the control, suggesting that APOE gene shortage leads to reduction of network elasticity and thus to increased bone fragility. The latter are in accordance with previous data of our group for osteoporotic rats.

Raman analysis of animal models showed that only collagen cross-linking formation, with regard to bone structure, is gene controlled while mineralization remains unaffected. Furthermore, APOE gene is related to osteoporosis and subsequent increased bone fracture risk.