



Hypodynamia Alters Bone Quality and Trabecular Microarchitecture

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Disuse induces a rapid bone loss in humans and animals; hypodynamia/sedentarity is now recognized as a risk factor for osteoporosis. Hypodynamia also decreases bone mass but its effects are largely unknown and only few animal models have been described. Hypodynamic chicken is recognized as a suitable model of bone loss but the effects on the quality have not been fully explored. We have used ten chickens bred in a large enclosure (FREE group); ten others were confined in small cages with little space to move around (HYPO group). They were sacrificed at 53 days and femurs were evaluated by microcomputed tomography (microCT) and nanoindentation. Sections (4 μm thick) were analyzed by Fourier Transform InfraRed Microspectroscopy (FTIR) to see the effects on mineralization and collagen and quantitative backscattered electron imaging (qBEI) to image the mineral of the bone matrix. Trabecular bone volume and microarchitecture were significantly altered in the HYPO group. FTIR showed a significant reduction of the mineral-to-matrix ratio in the HYPO group associated with an increase in the carbonate content and an increase in crystallinity (calculated as the area ratio of subbands located at 1020 and 1030 cm^{-1}) indicating a poor quality of the mineral. Collagen maturity (calculated as the area ratio of subbands located at 1660 and 1690 cm^{-1}) was significantly reduced in the HYPO group. Reduced biomechanical properties were observed at the tissue level. Confined chicken represents a new model for the study of hypodynamia because bone changes are not created by a surgical lesion or a traumatic method. Animals have a reduced bone mass and present with an altered bone matrix quality which is less mineralized and whose collagen contains less crosslinks than in control chicken.

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