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Characterization of Bone Mineral Composition in the Proximal Tibia of Cynomolgus Monkeys Using Infrared Microspectroscopy

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Like post-menopausal women, ovariectomized cynomolgus monkeys (*Macaca fascicularis*) experience accelerated loss of bone mass. However, treatment of ovariectomized monkeys with nandrolone decanoate results in an increase in bone mass to levels comparable to those in intact animals. The changes in bone composition that occur with these treatments, however, are less well characterized. In the present study, we used synchrotron FTIR microspectroscopy and curve-fitting methods to monitor specific changes at cortical, subchondral, and trabecular bone regions in the proximal tibia. Four groups were studied: (1) Sham operated (SHAM), (2) ovariectomized (ovx) and treated with placebo for two years (OVX), (3) ovx + nandrolone decanoate for two years (NAN), and (4) ovx + nandrolone decanoate beginning one year after ovx (dNAN). Results demonstrate that ovariectomy and nandrolone treatment do not affect the degree of mineralization as defined by the phosphate / protein ratio, but acid phosphate content (HPO_4^{2-}) in cortical and subchondral bone is increased by ovariectomy, suggesting that this bone is less mature due to increased remodeling that occurs after ovariectomy. In the subchondral and cortical bone regions, ovariectomized monkeys have lower total carbonate content (CO_3^{2-} / matrix ratio) than the SHAM controls, specifically from a decrease in labile carbonate content. In the trabecular region, no change of carbonate content was observed. Treatment with nandrolone decanoate restores the loss in carbonate, where the resulting mineral has a greater amount of type B carbonate. Finally, we have correlated carbonate content with DEXA measurements, and we find a positive correlation between BMD and type A carbonate in bone, which is stoichiometrically related to the amount of calcium in bone. Therefore, the results presented here identify significant differences in bone chemistry after ovariectomy and nandrolone treatment, which may help explain previous findings that, although nandrolone decanoate treatment increased bone mass, it could not reverse the decrease in bone strength due to ovariectomy (Aerssens et.al. *Calcif. Tissue Int.* 53: 269-277, 1993).