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The effect of magnesium-insufficiency, a risk for osteoporosis, on bone minerals

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Summary

Mg-insufficient bone reveals fragility to mechanical loading despite normal or higher levels of bone mineral content (Kobayashi et al., Bone 35:1136, 2004). Therefore, we have examined bone remodeling and mineral of the tibiae and femora of 4-week-old Wistar male rats fed normal (control group, 0.09% Mg) or Mg-insufficient (low Mg group, 0.006% Mg) for 4-weeks. The termini of the shortened metaphyseal trabeculae of low Mg groups localized many osteoclasts with well-developed ruffled borders. In addition, the Mg-insufficient cortical bones showed complicated meshwork of cement lines, implying accelerated bone remodeling. Thus, Mg-insufficiency appeared to enhance osteoclastic bone resorption, thereby accelerating bone remodeling. An electron probe microanalyzer demonstrated an increased and decreased concentrations of Ca and Mg in the low Mg group, respectively. X-ray diffraction provided various chemical formulae of mineralized crystals including hydroxyapatites (HA) in the control group, but an extremely-elevated purity of HA [$Ca_{10}(PO_4)_6(OH)_2$] in the low Mg group. Consistently, Mg-insufficient bone showed large mineralized nodules and premature mineralization of collagen fibrils in the osteoid. Therefore, an increased concentration of Ca in the Mg-insufficient bone may cause the high purity of HA, larger mineralized nodules and premature collagenous mineralization. Thus, in a physiological state, Mg appears to take part in “bone quality” by different mechanisms on bone turnover and mineralization.