Partial weightbearing at 1/6 and 1/3 G does not prevent deleterious changes in bone observed with traditional tail suspension (0 G)

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The effect of partial gravity (G) (as on the Lunar surface) on weight bearing bone remains undefined; a new model (the partial G mouse) provides for graded reductions in weight bearing. We hypothesized that mice exposed to 1/6th G and 1/3rd G (to mimic Lunar weightbearing with full spacesuit) will experience significant reductions in cortical and cancellous bone mass as compared to ambulatory control animals but that the magnitude of these changes would be less than in 0 G mice. Methods: Fifty-eight BALB/cBy female mice were randomly assigned to cage control (1G), "zero-gravity" hindlimb unloaded (0G), 1/6th gravity (G/6), or 1/3rd gravity (G/3) groups for a 21-day suspension protocol. Ex vivo pQCT scans (XCT-M Stratec; Norland Corp.) were performed at the proximal metaphyses and midshaft of the excised tibia and humerus to measure volumetric bone mineral density (vBMD), bone mineral content, and cross-sectional geometry. Results: Total body mass significantly decreased 7.6% in 0G mice but not in the G/3 or G/6 groups. Total vBMD at the proximal humerus was significantly lower in the 0G, G/6, and G/3 mice compared to the 1G mice. Cortical area and thickness at the humerus midshaft were significantly lower in the 0G, G/6, and G/3 mice compared to the 1G mice. Cortical density at the midshaft of the humerus exhibited significant reductions in the 0G and G/6 mice, but not in G/3 mice. Total vBMD at the proximal tibia was significantly lower in the 0G, G/6, and G/3 mice compared to the 1G mice, with no differences among the 0G, G/3, or G/6 groups . Relative to the 1G group, cortical shell BMC at the proximal tibia was significantly lower in the 0G, G/6, and G/3 mice but did not differ among the unloaded mice. Conclusion:These data suggest that partial weight bearing (as high as 1/3rd G) does not provide enough mechanical loading to prevent the significant deterioration of most cortical or cancellous bone parameters observed in the 0G non-weight bearing condition.

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