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APPARENT LUMBAR BONE MINERAL DENSITY AS MEASURED BY DXA DURING BED REST IS HIGHLY INFLUENCED BY INCREASE OF INTERVERTEBRAL DISC HEIGHT

Abstract

Background: Measurement of bone loss at the lumbar spine during bed rest studies are regularly performed by assessing areal bone mineral density (aBMD) by means of Dual Energy Absorptiometry (DXA). DXA aBMD at the lumbar spine is part of the ESA bed rest core data and NASA standard measures. In long-term bed rest studies the aBMD of the lumbar spine typically decreases over the time of head down tilt (HDT) phase while getting back to pre-bed rest values immediately after recovery (R). In contrast, aBMD at the proximal femur is reduced until up to one year after recovery or even longer. Objective: The purpose of this study was to investigate the so far inexplicable behavior of aBMD at the lumbar spine during HDT with immediate return to baseline values only three days after return to upright position as measured on R+3. Materials and Methods: DXA measurements of the lumbar spine of twenty-three healthy male participants were performed at baseline, 4 times during head-down-tilt bed-rest phase and 4 times in recovery phase up to day 360 in the RSL study. As an increase of height of the lumbar intervertebral discs is known from MRI measurements, the DXA scans were re-evaluated to determine whether an increase in the height of the region of interest might contribute to (presumably) falsely reduced aBMD contents during bed rest. Results: By standard DXA measurement, a decrease of aBMD of the lumbar spine was shown between baseline and HDT60 of -1.61% in the control (CTRL) and -2.48% in the physical intervention (JUMP) group. Three days after recovery from bed rest, aBMD returned to baseline value in both groups. The total area of interest for L1 to L4 increased during the bed rest phase due to increased height of the intervertebral discs and returned to baseline values at R+3. The standard DXA analysis software therefore included a greater area of intervertebral discs into the region of interest for the aBMD analysis during HDT phase, leading to falsely reduced aBMD values. Conclusion: Measurement of aBMD at the lumbar spine in bed rest studies by means of DXA could be misleading and the value of measurement points during head-down tilt phase should be reconsidered.