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Author: Dr. Gabriele Armbrecht
Charité - University Medicine Berlin, Germany

Mr. Fabio Pivetta
Charité - University Medicine Berlin, Germany
Dr. Roswitha Dietzel
Charité - University Medicine Berlin, Germany
Dr. Ulf Gast
Germany
Dr. Edwin Mulder
German Aerospace Center (DLR), Germany
Prof. Dieter Felsenberg
Charité - University Medicine Berlin, Germany
Prof. Daniel Belavy
Australia

CHANGES IN LUMBAR VERTEBRAL BODY BONE TEXTURE AS AN INDEX OF BONE MICROARCHITECTURE IN BED REST STUDIES USING TRABECULAR BONE SCORE (TBS)

Abstract

Background: Osteoporosis is a disease characterized by both low bone mass and structural deterioration of bone tissue leading to bone fragility and an increased risk of fractures. In space as well as in bed rest studies bone mass and areal bone mineral density (aBMD) of the lumbar spine as measured by means of Dual Energy X-ray Absorptiometry (DXA) decreases. Changes in the structural deterioration of the bone tissue cannot be assessed by standard DXA software but these changes contribute to overall fracture risk independently from bone density. Deterioration of bone texture as an index of bone microarchitecture of the lumbar vertebral bodies can be measured using Trabecular Bone Score (TBS). TBS is a textural index that evaluates pixel gray-level variations in the lumbar spine DXA image. It can be used in addition to fracture risks determined by DXA bone density alone. Objective: To investigate structural deterioration of the vertebral bodies during long term bed rest in addition to areal BMD as assessed by DXA. Materials and Methods: Twenty-three healthy male participants in the RSL study aged between 21 and 42 were confined to a 60-day 6 head-down-tilt (HDT) bed-rest phase. Participants were randomly allocated to the control group (CTRL n=11) or the training group (JUMP n=12). Changes of aBMD at the lumbar spine were assessed at baseline, several times during HDT and in recovery (R) up to 360 days. Additional to standard aBMD assessment the Trabecular Bone Score (TBS) was calculated. Results: aBMD at the lumbar spine decreased during HDT phase in both groups (CTRL -2.48%; JUMP -2.42%) and returned to baseline values immediately after recovery at R+3. During long term recovery up to R+360 aBMD increases compared to baseline in both groups (CTRL +0.81%; JUMP +1.65%). In contrast, TBS showed a slight increase (meaning a more competent bone microarchitecture) during HDT (CTRL +1.97%, JUMP +2.65%) but also returned to baseline values at R+3. Data on R+360 showed a decrease of TBS (CTRL -1.97%; JUMP -3.31%) indicating a more inhomogeneous bone structure with higher fracture risk. Conclusion: Changes in aBMD at the lumbar spine during HDT and recovery phase did not reflect the increase in structural deterioration of the trabecular bone leading to a higher fracture

risk as assessed by aBMD only, after long-term recovery. Data on lumbar spine aBMD in bed rest and spaceflight should be additionally analysed regarding deterioration of bone structure.