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Bone metabolic responses to bed rest in young and older men

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Background and Hypothesis: It is well known that immobilization, through reductions of musculoskeletal forces, leads to bone loss. This is well established for clinical conditions, such as stroke, spinal cord injury as well as for spaceflight and disuse models, such as experimental bed rest. Age is another condition that predisposes to bone loss, which is intimately linked to fractures in the elderly population. Bone turn-over is known to be reduced in the elderly, and animal studies suggest a blunted response of bone to mechanical stimuli at old age, and that old age might 'shield' against immobilization-reduced bone loss. Whether this applies also to humans is currently unknown. The aim of the present study therefore was to compare bone metabolic responses to bed rest in a group of young (23.4 (SD 2.9) Years, n=7) and older men (59.1 (SD 2.5) Years, n=8). It was hypothesized that bone metabolic responses would be generally blunted in older men.

Methods: A 14-day bed rest study was organized in the Orthopaedic hospital in Ankaran, Slovenia. Blood samples and 24-hour urine collections were obtained at baseline, on the 2nd, 5th, 10th and 14th day of bed rest, and on the 7th and 14th day of recovery. Urinary concentrations of the resorption markers CTX and NTX were assessed by ELISA, serum levels of the bone formation marker P1NP by RIA, and serum calcium levels were assessed by flame photometry. Linear mixed effects models were designed and run with the R statistical software package.

Results: All bone formation and resorption marker levels were substantially lower in the old than in the young subjects at baseline ($P < 0.01$). P1NP decreased by 21.6 (SE 9.7)% during bed rest in the young group only ($P = 0.042$), but not in the older group. The enhancement in P1NP that was seen after re-ambulation in the older group ($P < 0.001$) was not seen in the young group. Urinary NTX excretion was increased by 74.2 (SE 9.9)% during bed rest ($P < 0.001$), without any group differences ($P = 0.62$). Serum calcium levels were marginally affected by bed rest, with a the young group depicting a moderate increase from 2.44 (SE 0.03) mM at baseline to 2.53 (SE 0.04) mM during bed rest.

Discussion: The present study has replicated the expected result of a mitigated bone turnover in older men, as compared to young men. Although the moderate decline in bone formation that was seen in young men was obliterated in the older group, both groups depicted very similar responses in bone resorption. It therefore seems that the older human skeleton retains most of its potential to lose bone in response to immobilization.