

Scientific Reports, 2016, vol.6

Acute transcriptional up-regulation specific to osteoblasts/osteoclasts in medaka fish immediately after exposure to microgravity

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Abstract

© The Author(s) 2016. Bone loss is a serious problem in spaceflight; however, the initial action of microgravity has not been identified. To examine this action, we performed live-imaging of animals during a space mission followed by transcriptome analysis using medaka transgenic lines expressing osteoblast and osteoclast-specific promoter-driven GFP and DsRed. In live-imaging for osteoblasts, the intensity of osterix- or osteocalcin-DsRed fluorescence in pharyngeal bones was significantly enhanced 1 day after launch; and this enhancement continued for 8 or 5 days. In osteoclasts, the signals of TRAP-GFP and MMP9-DsRed were highly increased at days 4 and 6 after launch in flight. HiSeq from pharyngeal bones of juvenile fish at day 2 after launch showed up-regulation of 2 osteoblast- and 3 osteoclast- related genes. Gene ontology analysis for the whole-body showed that transcription of genes in the category "nucleus" was significantly enhanced; particularly, transcription-regulators were more up-regulated at day 2 than at day 6. Lastly, we identified 5 genes, *c-fos*, *jun-B-like*, *pai-1*, *ddit4* and *tsc22d3*, which were up-regulated commonly in the whole-body at days 2 and 6, and in the pharyngeal bone at day 2. Our results suggested that exposure to microgravity immediately induced dynamic alteration of gene expression levels in osteoblasts and osteoclasts.

<http://dx.doi.org/10.1038/srep39545>
