Effects of Low Intensity Vibration (LIV) on Murine Trabecular Bone Following Complete Estrogen Deprivation

[1]Pattyn, Ryan R.; [1]Pagnotti, Gabriel M.; [2]Mohammad, Khalid S.; [2]Guise, Theresa A.

[1]Indiana University School of Medicine, Department of Endocrinology, 980 W. Walnut St., Room C112, Indianapolis, IN 46202.

Background and Hypothesis: Post-menopausal, estrogen-receptor positive breast cancer patients treated with aromatase inhibitor (AI) experience musculoskeletal deficiencies resulting from complete estrogen (E_2) deprivation, making even moderate exercise difficult. Mechanical signals derived from low intensity vibrations (LIV) have been demonstrated to preserve bone in models of systemic bone loss and cancer-induced osteolysis. Therefore, we hypothesized that LIV may mitigate deficits in murine trabecular (Tb) bone microarchitecture resulting from complete E_2-deprivation.

Experimental Design: Twenty 4w female C57/BL6 mice were divided into LIV (n=10), which received mechanical signals (90Hz, 0.3g) 1x/d, 20min/d, 5d/w for 28w, and CTL-LIV (CTL: n=10). Complete E_2-deprivation was achieved through ovariectomy (OVX) on 9 week old mice plus AI (letrozole,10µg/SC/daily). *Ex-vivo* micro-computed tomography (µCT), mechanical compression, and dynamic histomorphometry were performed to quantify changes in bone quantity and quality at 28w.

Results: Via µCT, trabecular bone volume fraction (Tb.BV/TV) and connectivity density were significantly greater, 22% ($p<0.05$) and 52% ($p<0.01$), respectively, in LIV-mice when measured in the L5 vertebral body compared to CTL. Vertebral bodies of LIV showed a significantly more uniform distribution of trabeculae ($p<0.01$) in L5 and significantly greater, 11% ($p<0.05$), trabecular thickness in L4 than CTL. Trabecular bone formation rate and mineralizing surface in distal femora were significantly greater, 43% ($p<0.01$) and 31% ($p<0.01$), respectively, in LIV versus CTL. No differences in mechanical properties of the thoracic vertebrae between LIV and CTL resulted from mechanical compression.

Conclusion: Daily LIV administration significantly improved trabecular bone microarchitecture and trabecular bone homeostasis in E_2-deprivated mouse model. Our data suggests LIV may maintain trabecular bone mass in the lumbar spine and could enhance bone formation in post-menopausal, E_2-receptor positive breast cancer patients undergoing AI treatment.

Ryan Pattyn is a third-year medical student who is undecided in his specialty of interest. Reflecting upon his IMPRS research involvement, Pattyn found that the skills he developed—building a knowledge base, performing tests/procedures, and analyzing data—have applications beyond research to the clinical practice in his clerkships and beyond.