



Complex Interactions Between Estrogen, Strain, and Exercise-Induced Periosteal Bone Growth

The Harvard community has made this article openly available. [Please share](#) how this access benefits you. Your story matters

Citation	Devlin, Maureen and Daniel E. Lieberman. 2007. Complex interactions between estrogen, strain, and exercise-induced periosteal bone growth. Abstracts of AAPA poster and podium presentations. American Journal of Physical Anthropology 131(S44): 99.
Published Version	http://dx.doi.org/10.1002/ajpa.20577
Citable link	http://nrs.harvard.edu/urn-3:HUL.InstRepos:2894775
Terms of Use	This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA

Complex interactions between estrogen, strain, and exercise-induced periosteal bone growth

Maureen Devlin, Daniel E. Lieberman

Abstract:

Understanding the relationship between bone strain and bone growth is critical for interpreting variations in skeletal robusticity. Recently we presented a model for interactions between estrogen, strain, and periosteal bone growth, in which high estrogen (E₂) increases, and low (E₂) decreases, osteogenic responses to strain. We compared cortical growth in exercised and sedentary sheep (*Ovis aries*) with higher vs. lower estrogen levels, and showed that exercised animals with high E₂ added substantially more bone than those with lower E₂. However, without normal controls, it was unclear whether exercise-induced cortical growth was stimulated by high E₂, suppressed by lower E₂, or both. Here we present a broader test of interactions between E₂ levels (normal, low, high) and loading (exercised and sedentary). Low E₂ animals were vaccinated against GnRH to suppress estrogen, while high E₂ animals received estrogen implants. After 45 days, periosteal bone growth was measured at hindlimb midshafts. The results support the hypothesis that estrogen upregulates strain-induced cortical bone growth: exercised, high-E₂ animals grew 6-27% more bone than exercised animals with lower E₂ levels, or sedentary animals ($p < .05$). The effects of the anti-GnRH vaccine on bone growth are more complex. Assays showed that vaccinated animals had normal, not decreased, E₂ levels, but grew 34-39% less bone in response to exercise than normal controls ($p < .05$). This suggests the vaccine affected strain-induced bone growth without changing circulating E₂, an unexpected finding. These results demonstrate that variation in E₂ levels may produce differential growth response to similar mechanical loading through complex mechanisms.