

Local Bone Formation Due to Combined Mechanical Loading and Intermittent hPTH-(1-34) Treatment and its Correlation to Mechanical Signal Distributions

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Abstract

We evaluated the local response of cortical bone in the rat tibia due to combined treatment with synthetic parathyroid hormone, hPTH-(1-34), and mechanical stimulation by four point bending. Forty-eight female retired breeder Sprague Dawley rats were divided into six groups. Mechanically stimulated animals included the following groups: (1) Bend+PTH, (2) Sham+PTH, (3) Bend+Vehicle, (4) Sham+Vehicle. Non-mechanically stimulated animals included a (5) Control group that received neither loading nor injections, and a (6) PTH group that received only hPTH-(1-34) injections. The right limbs of mechanically loaded animals were exposed to a peak force of 50N for 36 cycles at 2Hz, three days per week for four weeks, and PTH treated animals received injections equivalent to 50 μ g/kg BW. Fluorochrome labeling was used to measure local formation at 12 sectors about the endocortical periphery. The distributions of endocortical bone formation were compared to the local formation differences between treatment groups and to a variety of potential mechanical stimuli signals. Results indicated that hPTH-(1-34) exerted a potent anabolic effect with near-uniform formation about the endocortical surface, and that localized formation peaks due to bending were further augmented in the presence of hPTH-(1-34) treatment. Correlation of formation patterns to

mechanical signal distributions highlighted several candidate signals including the mid-principal stress, the dilatational strain, and the radial gradient of the local radial strain.

Keywords

rat tibia, mechanical loading, parathyroid hormone, bone adaptation, finite element modeling