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Modeling of Periodic Load Effects in Bone Tissue Adaptation

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Bone functional remodeling is influenced by time characteristics of mechanical loading. Periodic loads usually have more effect on the adaptation and associated evolution of tissue structure than a static one. In the present work, an approach, based on the hypothesis of optimal response of bone, is proposed. It enables derivation for a viscoelastic material a family of adaptation formulas. In this derivation, an assumption is made that the bone is loaded harmonically, and that the frequency of oscillations is so small that the inertia effects are negligible. It follows that the stimulus is frequency dependent and that functional relation between stimulus and load frequency depends on the constitutive material model applied in the formulation. In some cases, the stimulus grows to some maximal value and next drops to zero with steering to infinity frequency of load oscillations what was already observed in experiments. The results of sample computer calculations are included. The proposed approach might offer an attractive tool in investigations of frequency effect on bone remodeling but more research and experimental confirmation are necessary.

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