Architectural adaptation of bone to mechanical loading

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Abstract

The effects of physical exercise on bone resistance have been proved in several studies.

Over the years, numerous investigations that reveal the positive effect of physical activity on bone mineral density have shown that these effects are localized and depend on specific sports activity. Differences in bone mineral density between athletes and sedentary subjects are shown in trabecular areas of the skeleton.

The skeleton strength depends largely on bone mineral density but also on bone architecture at macroscopic and microscopic scale (trabecular bone microarchitecture).

Bone overall geometry can be modified by physical exercise. It appears that mechanical stimuli have a positive effect on longitudinal bone growth. An elongation of bone segments between 1 and 3% was observed in the dominant upper limb of tennis players who began the practice of sport in childhood or adolescence. Cross-sectional studies have shown that mechanical loading improves bone resistance through cortical thickness adaptation.

In animals, an 8% increase in the bone trabeculae of the tibial epiphyses after three weeks of exercise on the treadmill has been demonstrated. Other microarchitecture adaptations have been highlighted by research: increased trabecular bone volume, reduced intratrabecular space, increased trabecular thickness.

Knowledge of the effects of mechanical loading on bone architectural parameters is necessary to optimize the benefits of physical activity on bone strength.

Keywords: mechanical stimuli, bone microarchitecture, physical activity.