A materials science perspective on bone growth and regeneration

Peter Fratzl,

Max Planck Institute of Colloids and Interfaces, Department of Biomaterials, Potsdam, Germany

Our skeleton needs to carry the body weight and to resist mechanical impacts. This capability or, conversely, bone fragility are controlled by the amount of bone mass, the shape and internal architecture of the bones, as well as by the material of which they are built(*1-3*). Bone material consists of a complex multi-scale arrangement of mineralized collagen fibrils containing mineral, water, proteoglycans as well as some non-collagenous proteins. This organization is by no means constant during our life time. It changes with growth and bone maturation, but even adult bone is constantly remodeled and, thus, able to repair damaged tissue and to adapt to the loading situation. In preventing fractures, the most important mechanical property is toughness, which is controlled primarily by the intricate multi-scalar fiber arrangement of the tissue that develops during bone formation and maturation. However, how this complex structure is controlled and adapted through the action of bone forming cells remains a mystery. The talk will address recent in-vitro (*4-6*) and ex-vivo investigations (*7-11*) as well as numerical modeling (*12*) of bone tissue formation and regeneration that shed some light on this issue.

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