9-6-2012

The Study of Bone Diffusion in Canine Tibia

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Abstract

The provision of nutrients is imperative in order to maintain healthy bone structure. Bones are composed of dense connective tissues that are consistently reforming making it difficult for simple diffusion of large signaling molecules to occur. Fully understanding the rate at which nutrients, minerals, and waste travel throughout bone could lead to solutions to problems such as bone illnesses, breaks, and integration of prosthetics in the human body. Enhanced targeted medication delivery can be established as well.

In this particular case study, experimentation performed by K. Farrell in 2011 yielded an overall average diffusion coefficient of $1.3 \times 10^{-7} \pm 2.0 \times 10^{-8}$ cm²/s while the current experiments yielded average diffusion coefficients of $2.6 \times 10^{-6} \pm 1.5 \times 10^{-7}$ cm²/s. The results are an order of magnitude different. This difference could be attributed to the 2 orders-of-magnitude increase in solute concentration used in this work. Other possible explanations may be the increased age of the bone sample, during which the lipids and proteins may have degraded over time.

Diffusion coefficients differ among the quadrants of each section. This is, in some cases, due to the canaliculi and haversian canals within the sample.