The wave propagation of porous media including the electrokinetic effect to Biot's theory: application to cancellous bone

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ABSTRACT

Cancellous bone is a highly porous material with including the interstitial fluid and bone marrow. Clinically the ultrasound has been widely used by detecting the speed of sound (SOS) and/or the broadband ultrasound attenuation (BUA). These are parameters in determining the mechanical properties of cancellous bone and, recently, the structural parameter, so called fabric tensor was included in these parameters. Biot's theory is one type of theoretical formulations in determining these parameters. Other structural parameters, such as permeability and tortuosity are also important in cancellous bone. However, beyond these structural parameters we know the coupling effect between the streaming potential and bone fluid flow in cancellous bone. Streaming potential is an electrokinetic effect as bone fluid flows, however the streaming potential, or the electrokinetic effect was not included in cancellous bone. Thus we reformulate the Biot's theory by including electrokinetic effect for cancellous bone and examine it numerically in terms of structural parameters of the Biot's theory with and without electrokinectic effect or streaming potential. '

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