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A Structural Constitutive Model for Viscoelastic Rheological Behavior of Human Saphenous Vein Using Experimental Assays

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Abstract : Cardiovascular diseases are one of the most common causes of mortality in developed countries. Coronary artery abnormalities and carotid artery stenosis, also known as silent death, are among these diseases. One of the treatment methods for these diseases is to create a deviatory pathway to conduct blood into the heart through a bypass surgery. The saphenous vein is usually used in this surgery to create the deviatory pathway. Unfortunately, a re-surgery will be necessary after some years due to ignoring the disagreement of mechanical properties of graft tissue and/or applied prostheses with those of host tissue. The objective of the present study is to clarify the viscoelastic behavior of human saphenous tissue. The stress relaxation tests in circumferential and longitudinal direction were done in this vein by exerting 20% and 50% strains. Considering the stress relaxation curves obtained from stress relaxation tests and the coefficients of the standard solid model, it was demonstrated that the saphenous vein has a non-linear viscoelastic behavior. Thereafter, the fitting with Fung’s quasilinear viscoelastic (QLV) model was performed based on stress relaxation time curves. Finally, the coefficients of Fung’s QLV model, which models the behavior of saphenous tissue very well, were presented.

Keywords : Viscoelastic behavior, stress relaxation test, uniaxial tensile test, Fung’s quasilinear viscoelastic (QLV) model, strain rate
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