The epicardial coronary arteries experience significant torsion in the axial direction due to changes in the shape of the heart during the cardiac cycle. The objective of this study is to determine the torsional mechanical properties of the coronary arteries under various circumferential and longitudinal loadings. The coronary artery is treated as a two-layer composite vessel consisting of intima-media and adventitial layers and the shear modulus of each layer is determined. Twelve hearts were obtained at a local slaughter house and their RCA and LAD arteries were tested in vitro using a tri-axial torsion machine where the vessel was inflated, longitudinally stretched and circumferentially twisted along its length. After the intact vessel was tested, the adventitia was dissected away leaving an intact media which was then tested under identical tri-axial loading conditions. A biomechanical analysis was proposed to compute the shear modulus of the adventitia from the measured shear moduli of the intact vessel and the media. To validate our predictions, we used five additional hearts where the shear modulus of the adventitia was measured after dissection of media. Our results show that the shear modulus does not depend on the shear stress or strain but varies with the circumferential and longitudinal stresses and strains. Furthermore, we found that the shear modulus of the adventitia is larger than that of the intact vessel which is larger than the vessel media. These results may have important implications on baroreceptor sensitivity, circulation of the vasa vasorum, and coronary dissection.