Determination of Poisson's Ratio and Elastic Modulus of Compression Textile Materials

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Abstract : Compression textiles such as compression stockings (CSs) have been extensively applied for the prevention and treatment of chronic venous insufficiency of lower extremities. The involvement of multiple mechanical factors such as interface pressure, frictional force, and elastic materials make the interactions between lower limb and CSs to be complex. Determination of Poisson's ratio and elastic moduli of CS materials are critical for constructing finite element (FE) modeling to numerically simulate a complex interactive system of CS and lower limb. In this study, a mixed approach, including an analytic model based on the orthotropic Hooke's Law and experimental study (uniaxial tension testing and pure shear testing), has been proposed to determine Young's modulus, Poisson's ratio, and shear modulus of CS fabrics. The results indicated a linear relationship existing between the stress and strain properties of the studied CS samples under controlled stretch ratios (< 100%). The newly proposed method and the determined key mechanical properties of elastic orthotropic CS fabrics facilitate FE modeling for analyzing in-depth the effects of compression material design on their resultant biomechanical function in compression therapy.

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