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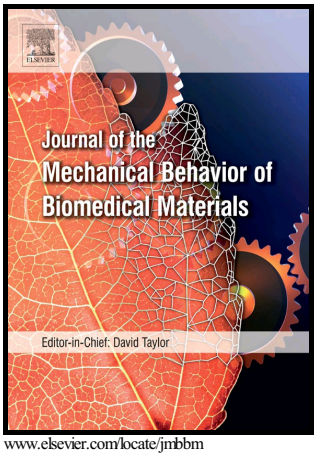

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Comparison of different constitutive models to characterize the viscoelastic properties of human abdominal adipose tissue. A pilot study.

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Abstract

Knowing the mechanical properties of human adipose tissue is key to simulate surgeries such as liposuction, mammoplasty and many plastic surgeries in which the subcutaneous fat is present. One of the most important surgeries, for its incidence, is the breast reconstruction surgery that follows a mastectomy. In this case, achieving a deformed shape similar to the healthy breast is crucial. The reconstruction is most commonly made using autologous tissue, taken from the patient's abdomen. The amount of autologous tissue and its mechanical properties have a strong influence on the shape of the reconstructed breast. In this work, the viscoelastic mechanical properties of the human adipose tissue have been studied. Uniaxial compression stress relaxation tests were performed in adipose tissue specimens extracted from the human abdomen. Two different viscoelastic models were used to fit to the experimental tests: a quasi-linear viscoelastic (QLV) model and an internal variables viscoelastic (IVV) model; each one with four different hyperelastic strain energy density functions to characterise the elastic response: a 5-terms polynomial function, a first order Ogden function, an isotropic Gasser-Ogden-Holzapfel function and a combination of a neo-Hookean and an exponential function. The IVV model with the Ogden function was the best combination to fit the experimental tests. The viscoelastic properties are not important in the simulation of the static deformed shape of the breast, but they are needed in a relaxation test performed under finite strain rate, particularly, to derive the long-term behaviour (as time tends to infinity), needed to estimate the static deformed shape of the breast. The so obtained stiffness was compared with previous results given in the literature for adipose tissue of different regions, which exhibited a wide dispersion.

Keywords:

human adipose tissue, abdomen, stress relaxation test, viscoelasticity, mechanical properties

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