Numerical identification of initial stress within in vivo human skin

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abstract:

It is well-known that the mechanical behaviour of in vivo human skin is viscoelastic, non linear and anisotropic. Many experimental researches have been undertaken in order to evaluate the mechanical properties of this biological tissue and have led to propose reliable mechanical modellings of in vivo skin. Nevertheless, it is necessary to take into account the natural stress of the skin in order to assess predictive models.

Several authors developed experimental devices to determine this natural tension; others consider it as a parameter of the global behaviour.
The present study aims at determining the field of natural tension stresses in human skin (in vivo). Cutaneous samples are taken to follow the evolution of the shape of the region free from stresses. The stress field at the boundary of the sought region is identified by the inverse method using a finite element calculation. First, the human skin is considered as a isotropic, linear elastic sample. Second, the orthotropic behaviour of the skin is taken into account. And it is possible to show that an orthotropic model with isotropic boundary conditions is able to seem like a isotropic model with orthotropic boundary ones. This method provides data stating as reference for the functional state and allowing the interpretation of the experimental tests of in vivo mechanical investigations.