Inclusion or exclusion of compressed fibres in the mechanics of fibrous soft biological tissues

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Abstract

Collagen fibres within soft fibrous tissues such as artery walls and the myocardium have an important load-bearing and reinforcing role and are therefore key contributors to both structural and mechanical properties of the tissues. In general, depending on, for example, the type of tissue, and the changes in collagen fibre arrangement with disease, the arrangement of collagen fibres is highly dispersed. Continuum mechanical models that accommodate fibre dispersion within a non-collagenous matrix have been developed in recent years, and there are two main approaches for modelling this dispersion in the context of the mechanics of soft biological tissues. First, there is the *angular integration* (AI) approach, which was formulated by Lanir [1], and, second, the *generalized structure tensor* (GST) approach, formulated by Gasser et al. [2].

It is often considered in the literature that only fibres that support tension should contribute to the mechanical response of the tissue and that fibres under compression should be excluded. For the AI approach the papers by Holzapfel and Ogden [3] and Li et al. [4] provide, respectively, theoretical and computational frameworks, with examples, for just such an exclusion. On the other hand, it has been suggested in the literature that it is not possible to exclude compressed fibres within the GST approach. This is not, however, the case, as has been demonstrated in the recent paper by Holzapfel and Ogden [5].

In this presentation we highlight the quite different mechanical responses that are obtained by inclusion or exclusion of compressed fibres.

References

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