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DIFFERENCES IN THE MECHANICAL RESPONSE BETWEEN LIVE AND DEAD SKELETAL MUSCLE

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Abstract

With the widespread use of human cadavers in automotive safety test programs, the question of the field relevance and comparability of the results with the living human response has been repeatedly raised. Since the kinematic response of human subjects is controlled mainly by the large skeletal muscle mass supporting actively or passively important skeletal joints, biomechanical tissues response was studied in both the living and postmortem states on isolated muscles in an animal model.

First of all, the biomechanical response of the skeletal muscle changes considerably following death and postmortem storage. Although the living tissue is basically elastic at the deformations studied, viscous dissipating character of the postmortem material indicates a significant increase in rate dependence. The free viscous character of the tissue also dictates the need to limit handling of cadavers to prevent mechanical damage prior to testing. The inevitable postmortem occurrence of rigor mortis or the introduction of any chemical whole-body preservation stiffens the muscle tissue to the same degree as a supraliminal electrical stimulation leading to a maximal muscle contraction *in vivo*. However, the energy dissipation mechanisms are different. The embalmed tissue is extremely rigid and elastic. The rigor mortis tissue loses its stiffness following a single cyclic loading. Thus, even slight regularly occurring mechanical deformation during transportation and preparation of cadavers with established rigor mortis may uncontrollably modify the induced stiffness of the tissue.

The data are of a descriptive or qualitative nature only and a quantification of the mechanical properties of skeletal muscle under various times, temperature and storage conditions is urgently needed. By using either discrete physical models or more advanced hereditary formulations, the data can be quantified in mathematical models of the whole body response and lead to correction factors to predict the real human response.