TOWARDS AN UNDERSTANDING OF STRETCH ACTIVATION IN INSECT FLIGHT MUSCLE

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Small-angle x-ray diffraction has told us much about what we know about the molecular mechanism of muscle contraction. The difficulty of doing these experiments has provided a driving force for the development of x-ray technologies for over 50 years. Now that there is little doubt that muscle works by a "swinging lever arm" mechanism, focus can now shift to studying the molecular bases of regulation in muscle that may have implications for human health. In particular, the phenomenon of stretch-dependent activation is an important, and poorly understood, property of cardiac muscle where the contraction of one region stretch-activates neighboring regions aiding ejection during a heart-beat. We have been using the indirect flight muscles (IFM's) of insects as model systems to study mechanisms of length-dependent activation not only because the phenomenon of stretch activation is particular strong in these muscles but also because their high degree of structural order permits much more detailed analysis than would be possible with cardiac tissue. Dickinson et al. (2005, Nature, 433:330), on the basis of their time resolved fiber diffraction study of living Drosophila during tethered flight, proposed a model for stretch activation where strain in the thick filaments is transmitted to the thin filaments via bound myosin cross-bridges. Here we discuss this model in the context of new fiber diffraction data from the giant waterbug Lethocerus and indicate some future directions.