Nathan Gasek
Student Research Conference Abstract

The Contributions of the Amino and Carboxyl Terminal Domains of Flightin to the Biomechanical Properties of Drosophila Flight Muscle Thick Filaments

Abstract:

Myosin is paramount for the generation of force by muscle cells. While the mechanisms by which the myosin motor head domain generates force through its power stroke are well known, there exists a substantial knowledge gap surrounding the function of the myosin rod domain. Though it has been implicated in the polymerization of myosin, the means through which this coiled-coil rod domain interacts with associated proteins to define the assembly, structural, and biomechanical properties of thick filaments is not fully understood. Flightin, a myosin binding protein expressed in the Indirect Flight Muscles of Drosophila, contributes to the regulation of thick filament length and rigidity, properties that directly impact flight muscle function. Analysis of flightin's amino acid sequence revealed three distinct putative domains, each of which reflects varying degrees of evolutionary conservation; a highly conserved 'WYR' central domain and less conserved amino and carboxy terminal domains. While previous studies have shown that deletion of the amino and carboxy terminal domains of flightin impair muscle structure and function to varying degrees, the direct contributions of each domain to thick filament length determination and rigidity remain unknown. Building upon prior investigations, Atomic Force Microscopy was used to examine the biomechanical properties of isolated thick filaments from transgenic Drosophila expressing flightin that lacked either the amino or carboxy terminal domains. Expression of the amino terminal truncated flightin results in significantly shorter thick filaments (2.68±0.08 μm; ($p < 0.005$)) while truncation of the carboxy terminal domain has no effect on filament length (3.21±0.07 μm; $p > 0.05$) compared to control (3.29±0.07 μm). In contrast, persistence length (an index of filament rigidity) is significantly reduced in filaments expressing the carboxy terminal deleted flightin (418±72 μm; $p < 0.005$) but not in those expressing the amino terminal deleted flightin (1133±193 μm; $p > 0.05$) as compared to control (1747±354μm). These results indicate that the amino and carboxy terminal domains of flightin make distinct contributions to the structural and biomechanical properties of thick filaments.