

DEVELOPMENT OF A SENSITIVE FORCE TRANSDUCER FOR USE WITH LARVAL *DIPTERAN* MUSCLE

Julia C. Dettinger

The relationship between motoneuron activity and force generation in muscle is often described as monotonic, such that force can be simply predicted from any given motoneuron rate (e.g., Martini 2001; Purves et al., 2004). In many preparations, spanning diverse taxa, the relationship is more complex. A muscle that is activated by equivalent stimulus rate and strength may generate profoundly different forces under different conditions. Factors that contribute to inequalities in the motoneuron rate – muscle force relationship include changes at the neuromuscular synapse as well as intramuscular dynamics such as hysteresis. The latter category of factors remains somewhat poorly understood. It has been demonstrated that hysteresis can result in force generation greater (or lesser) than that predicted by the simple monotonic relationship in many arthropods (Blaschko et al., 1931; Wilson and Larimer, 1968). This study seeks to determine whether hysteresis can be measured and characterized in larval fly muscle. Fly larvae are ideal for this type of research because their anatomy, physiology and behavior are relatively simple. The final stage of larval development in many *Dipterans* can be characterized by increased locomotion. This study uses this increased larval locomotion to create a cross-species analysis of hysteresis in *Dipteran* larvae, including *Muscidae*, *Calliphoridae*, and *Sarcophagidae*. In order to measure the small forces generated by these larval muscles, we have specially designed a highly sensitive force transducer.

The force transducer is designed from two pairs of semi-conductors mounted on a cantilever acting to measure tension and compression. These strain gauges are configured in a Wheatstone Bridge circuit. The Wheatstone Bridge circuit passes voltage equally through two legs, each consisting of a pair of strain gauges. As the cantilever bends it changes the molecular structure of the semi-conductor strain gauges, thus changing the resistance to passage of voltage through the Wheatstone Bridge. This change in voltage is proportional to force via a simple, linear function. Physiological results indicate that larval *Dipteran* muscles behave like most arthropod slow muscle (and thus unlike adult flight muscles of these flies). Moreover, preliminary results suggest that hysteresis acts in the larger larvae much as has been reported in other insects.

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