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Myosin head power stroke does not obey predictions based on the swinging lever arm mechanism of muscle contraction

Ithough more than 50 years have passed since the monumental discovery of sliding filament mechanism in muscle A contraction, the molecular mechanism of myosin head movement, coupled with ATP hydrolysis, is still a matter for debate and speculation. A most straightforward way to study myosin head movement, producing myofilament sliding, may directly record ATP-induced myosin head movement in hydrated, living myosin filaments using the gas Environmental Chamber (EC) attached to an electron microscope. While the EC has long been used by material scientists for the in situ observation of chemical reaction of inorganic compounds, we are the only group successfully using the EC to record myosin head movement in living myosin filaments. We position-mark individual myosin heads by attaching gold particles (diameter, 20 nm) via three different monoclonal antibodies, attaching to at the distal region of myosin head Catalytic Domain (CAD), at the myosin head Converter Domain(COD) and at the myosin head Lever arm Domain (LD). First, we recoded ATP-induced myosin head movement in the absence of actin filaments and found that myosin heads moved away from, but not towards the central bare region of myosin filaments. We also succeeded in recording ATP-induced myosin head power stroke in actin-myosin filament mixture. Since only a limited proportion of myosin heads can be activated by a limited amount of ATP applied, myosin heads only move by stretching adjacent sarcomere structures. As shown in Figure-1, myosin head CAD did not move parallel to the filament axis in the standard ionic strength (B), while it moved parallel to the filament axis (C). These results indicate that myosin head movement does not necessarily obey predictions of the swinging lever arm hypothesis appearing in every textbook as an established fact.

Biography

Haruo Sugi has completed his PhD at University of Tokyo and was appointed as an Instructor in Physiology in the University of Tokyo Medical School. He has worked at Columbia University as a Research Associate and at the National Institutes of Health as a Visiting Scientist. He was the Professor and Chairman in Teikyo University Medical School when he became Emeritus Professor. He was Chairman of Muscle Commission in the International Union of Physiological Sciences (IUPS). He has organized symposia on molecular mechanism of muscle contraction six times; each followed by proceeding published from University of Tokyo Press, Plenum, Kluwer and Springer and regarded as milestones of progress in this area of research work.

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