Why muscle ultrastructure?

It is important to know the ultrastructural components of muscle in order to understand the concepts introduced in the muscle physiology series.

For example, the interaction of ultrastructural proteins-actin and myosin- generate muscle contraction in response to elevation of calcium. This elevation of calcium is discussed in the NMJ and Excitation Contraction Coupling modules.

We next introduce muscle ultrastructure before describing the detailed molecular mechanisms of muscle contraction.
Myosin (Thick) Filament

Myosin is the “motor” of the muscle unit. Ultrastructurally, the myosin appears as a thick band (filament) in striated muscle. The filament consists of >200 myosin molecules.

Myosin molecule: 6 polypeptide chains – 2 paired heavy chains & 4 light chains (two on each heavy chain).

Heavy chains: α-helical structure (double helix) coiled “tail”, and 2 globular heads (crossbridges). The actin binding site and ATP hydrolase are located in the crossbridges.

Light chains: at the base of the crossbridges, two per heavy chain.
Actin (Thin) Filament  3 proteins: actin, tropomyosin, troponin

Binding site for myosin crossbridges

Actin molecule, globular or G-actin
Actin (Thin) Filament 3 proteins: actin, tropomyosin, troponin

- Binding site for myosin crossbridges

Actin molecule, globular or G-actin

G-actin molecules polymerize to form F-actin filament, with a helical arrangement
Actin (Thin) Filament  

3 proteins: actin, tropomyosin, troponin

Binding site for myosin crossbridges

Actin molecule, globular or G-actin

G-actin molecules polymerize to form a filamentous or F-actin, with a helical arrangement

Upon binding calcium, troponin rotates tropomyosin to uncover myosin binding sites in the F-actin cleft

Troponin and tropomyosin regulate interaction of myosin crossbridges with actin. Tropomyosin is a filamentous protein that blocks the myosin-binding sites on actin. Troponin: is a complex of 3 globular proteins (T, I and C).

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Myosin and Actin

Myosin binding to Actin results in muscle contraction.

The myosin functions as a motor and pulls on actin to contract muscle.

This is discussed in the next section of cross bridge cycling.
End of Muscle Ultrastructure