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Functional morphology of serially linked skeletal muscle fibers

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Abstract

In the skeletal muscle fiber organization of many vertebrate muscles, serial arrangements or linkages of muscle fibers along the muscle or fascicle are commonly found. These serially linked muscle fibers employ distinct junctional morphologies from muscle to muscle. Notable are the end-to-end linkages of muscle fibers through tendinous intersections (TIs), where many fibers end onto a continuous connective tissue plate with folded terminations similar to myotendinous junctions. Besides this end-to-end linkage, overlapping linkages or arrangements occur among nonspanning fibers terminating intrafascicularly. These nonspanning fibers bear tapering terminations with direct cell-cell (myomuscular) junctions or without any specialized junctions. Despite their overlapping linkages or tapering profiles, nonspanning fibers maintain a uniform sarcomere length along the linked fibers, suggesting that the overlapping-linked nonspanning fibers are equivalent to the end-to-end linked fibers in their mechanical capacity. However, the junctional compliance could differ in their extracellular elastic components and their organization at junctional sites, e.g., direct mechanical (myomuscular) junctions vs. indirect linkages through connective tissue. Increasing evidence suggests that the elastic components, including muscle fibers as well as connective tissues, are more critical than previously thought for the mode and/or the efficiency of tension transmission among serially arranged fibers and thus for the mechanical properties of the muscle.