Altered afferent response of restrained antagonistic muscles after passive stretching of Gastrocnemius indicate a remarkable role of epimuscular myofascial force transmission in the sensory level

[1] Ö. Emre Arıkan, [2] Peter A. Huijing, [1] Burak Güçlü and [1] Can A. Yucesoy
[1]Biomedical Engineering Institute, Boğaziçi University, Istanbul , Turkey,
[2]Faculteit Bewegingswetenschappen, Vrije Universiteit, Amsterdam, the Netherlands

Substantial differences between the forces measured at the proximal and distal tendons of a muscle [1] have shown a major role of also non-tendinous structures in muscular force transmission: epimuscular myofascial force transmission [2]. Such force transmission was shown to cause substantial strain distributions along muscle fibers indicating serial heterogeneity of sarcomere lengths [3]. Moreover, our recent studies showed evidence on sizable inter-antagonistic epimuscular myofascial force transmission [4, 5]. We hypothesized that epimuscular myofascial force transmission can play a role in afferent signals generated in muscle sensory organs i.e., muscle spindles and Golgi tendon organs. The goal of our present study was to test this hypothesis by measuring the afferent firing rates of antagonistic muscles of the lower leg.
Gastrocnemius muscle of the frog (*Rana ridibunda*) was given a ramp-and-hold stretch of various amplitudes via a pulley mechanism connected to its distal tendon. Amplitude of stretch varied from 1 to 5 mm, with 1 mm increments between successive measurements. Keeping the ankle and knee angles fixed (at 100° and 120°, respectively), multi-unit recordings were made from both tibial and peroneal branches of sciatic nerve simultaneously: afferent signals generated from both the lengthened gastrocnemius muscle and the restrained antagonistic muscles were recorded. Paired t-test was used in order to test the statistical significance of the differences between the firing rates measured for pre- and during ramp stretch phases.
Remarkably, imposing passive stretch resulted in a significant increase in the firing rates of the units of not only the lengthened muscle, but also of the restrained antagonists (e.g. for the restrained antagonists, for $l_{stretch}$= 1mm, 2 mm, 3 mm, 4 mm and 5 mm, p =0.051, 0.039, 0.017, 0.005 and 0.024 respectively; n=12). This novel finding suggests that due to epimuscular myofascial force transmission, stretching of the target muscle causes local length changes sensed by muscle spindles within the fibers of the antagonistic muscles, despite being restrained. Our results therefore provide a preliminary support to our hypothesis and are likely to have major implications on our understanding of the functioning of muscular mechanoreceptors.

References

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