ANTAGONIST MECHANICAL CONTRIBUTION TO RESULTANT MAXIMAL TORQUE AT THE ANKLE JOINT IN YOUNG AND OLDER MEN
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Introduction
The performance of the neuromuscular system at one joint is usually assessed via the recording of a resultant torque that corresponds to the participation of both agonist and antagonist muscles. The primary goal of this study was to gain a better insight into the mechanical contributions of plantar- and dorsiflexor muscles to ankle joint resultant maximal voluntary contraction (MVC) torques, in young and older men. The assumption put forward was that an alteration in the estimated agonist torque should not automatically correspond to that of the measured resultant torque. Furthermore, it could be assumed that the aging process should have an impact on these mechanical contributions at the ankle joint.

Methods
Agonist and antagonist MVC torques at the ankle joint were estimated by means of an original and direct method used with 9 young (mean age 24 years) and 9 older (mean age 80 years) men. This technique consists in 1) measuring the EMG activity of the antagonist muscle during an isometric MVC, 2) measuring the torque produced by this muscle as it is now acting as agonist at the same EMG level as in 1) during a subsequent EMG biofeedback trial. The measured torque during the agonist EMG biofeedback trial is then taken to be equal to the antagonist torque during the prior MVC, i.e., the antagonist MVC torque.

To sum up:
Measured resultant MVC torque = Agonist MVC torque – Antagonist MVC torque
Antagonist MVC torque = Biofeedback torque

Tests were performed by using a footplate in a sitting position, with knee joint flexed at 120° (180° corresponding to full extension) and ankle joint at 90°.

Results
While there was a non-significant age-related decline in the measured resultant MVC DF torque (- 15 %, p = 0.06), there was a clear decrease in the estimated agonist MVC DF torque (39 %, p = 0.001). The DF-to-PF resultant MVC torque ratio was significantly lower in young than in older men (0.25 vs 0.31; p = 0.006), whereas the DF-to-PF agonist MVC torque ratio was no longer different between the two populations (0.38 vs 0.35, p > 0.05).

Conclusion
The model used in the present study requires few contractions to determine the antagonist torque. It avoids thus any fatigue effect and it is of special interest for an antagonist action assessment in an elderly population. Via this original method, it could be concluded that, in both DF and PF, the torques generated by the antagonist muscles were significantly lowered with aging. In DF, while the agonist MVC torque was significantly reduced with aging, there was a non-significant alteration in the resultant MVC torque, certainly induced by the weakness of the antagonist muscles, i.e., the plantarflexors, or by a strategy used by the older subjects. In addition, the findings of the present study showed that the performance of the dorsiflexors and the plantarflexors as agonists were similarly affected with aging, which could not be deduced when only resultant torques and coactivation were considered.

Keywords: Ankle, Strength, Muscle Plasticity

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