Contractile impairment of human muscle fibers caused by aging and by disuse

L. Cancellara[1], L. Toniolo[1], T. Moro[1], M. Venturelli[2], K. Koren[3], R. Pisot[3], C. Reggiani[1]

[1]*Departement of Biomedical Sciences, University of Padova, Padova, Italy*
[2]*Departement of Biomedical Sciences for Health, University of Milano, Milano, Italy*
[3]*University of Primorska, Slovenia*

Aim: Muscle contractile performance as measured from maximum power or from isometric force declines by aging and this decline can be further accelerated by disuse. In both conditions the functional impairment is accompanied by a loss in muscle mass (see for a recent review Blaauw et al. 2013). The contractile impairment can be studied at single fibre level by measuring cross sectional area (CSA), iso- metric force (Fo) and maximum shortening velocity (Vo) during maximal activation. Specific tension (Po) can be obtained as the ratio between Fo and CSA. Maximum power, in view of the shape of the force velocity curve, can be calculated as a fraction of the product of Po and Vo.
Methods: We recently studied the effect of aging in two distinct comparisons among single fibres dissected from biopsy samples of vastus lateralis: comparison (1) young women (age 20–25 years) vs. old women (age 85–95 years) in a collaborative study with the Uni- versity of Verona, and comparison (2) young men (age 20–30 years) vs. older adult (age 60–65 years) in a collaborative study with the University of Primorska (SLO).
Results: In both comparisons, the average cross sectional area (CSA) was found to be significantly lower in the old compared to the young subjects, while specific tension (Po, mN/mm^2) developed during isometric contraction was not significantly reduced. The effect of disuse was studied in the same group of subjects of comparison (2). Both the young and the older adult subjects were exposed to a bed-rest period of 2 weeks and their muscle fibres col- lected at the end with a new biopsy. The comparison pre- vs. post- bed-rest showed not only a significant decrease in the cross sectional area (-15 %) but also a significant reduction in specific tension developed during maximal isometric contraction.
Conclusions: The results provide a clear indication of the presence of two distinct mechanisms responsible of the decrease in the contractile performance of muscle fibres and related to physiological aging and, respectively, disuse.
Reference
Blaauw B, Schiaffino S, Reggiani C (2013) Mechanisms modulating skeletal muscle phenotype. Compr Physiol 3:1645–1687