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Editorial

Muscle function, Aging and Falls

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The treatment of osteoporosis which focuses only on bones ignores muscle function and balance elements connected to this disease, the prevention of falls and fractures[1]. Loss of balance leads to a fall: an uncontrolled involuntary downward movement in the direction of gravity with coming to rest on a deeper level[2]. It has to be counteracted by eccentric decelerating muscle action. The force we need for a movement against gravity is a summation of quickly released energy, which has been previously stored in elastic elements during (e.g. eccentric counter-movements), and currently generated muscle force by the actin-myosin-system[3].

Aging leads to loss of muscle mass: sarcopenia is a geriatric syndrome with progressive loss of mass, quality and function of skeletal muscles associated with aging[4]. On the other hand fat mass and extracellular space increases with age and creates a passive mass, which does not contribute to strength or power[5]. Menopause has also been linked to a reduction in lean mass (and bone mineral density). Limitations in physical function during the perimenopausal and postmenopausal periods are common in women. However, whether their age, hormonal or other factors are related is controversial[6]. There is debate about the positive association of muscle mass and estrogens, but the strength of evidence in support of an anabolic effect of estrogens on skeletal muscle via meta-analysis outweighs the evidence of no effect[7].

How can we measure muscle function, locomotion and risk of falling?

A correct answer would be the quantification of typical daily movements. However, in the current literature muscle function is measured by various devices and described by concepts that often do not agree with the rules and terms of physics[9].

From measurement of a particular muscle group, as is the case for grip strength, to time up and go test (TUG), Tinetti tests and Guralnik battery, which include some human subjectivity, and special maneuvers such as tandem walking, which uses dichotomous (yes/no) determinations, all these tests are useful to predict falls, hospitalization, sedentarism, immobilization and comorbidity etc[8]. However, no single methodology ideally quantitatively evaluates this decline in muscle mass.

In the study of muscle performance, movement has to be described in terms of velocity and acceleration. Isometric force measurement methods have the drawback of measuring forces which do not reproduce the physiological movement. Isokinetic methods also have the limitation of motion at a given angular speed, so this situation is far from normal.

Force causes acceleration, i.e. we have to know the forces involved in movement. Each movement is the action of force along a distance in a certain time, and therefore measured as power[3].

A modern technology called jumping mechanography (JM) may prove useful to quantitatively measure muscular function in older adults. JM appears to be a safe and potentially useful method to assess muscular function in older adults[10]. JM has also good test retest reliability compared with other tests[11].

We need to take in mind that there are also some limitations to well-established and useful tests for risk of falls and balance. For example time up and go (TUG) test only contains basic movements of everyday life such as lifting, walking, turning, and the seatting but not striding over an obstacle that can lead to a fall. Most modern studies according to Falls prevention are also using other tests like six minutes' walk test (6 MWT) as a performance-based measure of functional exercise capacity in other populations[12]. Finally, gait is a complex motor behavior and besides proper motor facets (i.e. velocity) is linked to different aspects of cognition[13].

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