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Biopsies were obtained from vastus lateralis in 6 young (24 years) and 6 old (68 years) healthy men before and after 14 days of lower limb disuse (whole-leg casting), and after 28 days of active recovery (resistance training). Myosin heavy chain (MHC) isoform composition and quantification of myosin content ($n = 349$ fibers) were determined by gel electrophoresis. In addition, single fiber specific force (SF = Ca^{2+}-activated force per cross-sectional area) was measured before and after disuse ($n = 281$ fibers). Before disuse, MHC I and IIa single fiber myosin content were similar in young and old. After disuse, myosin content decreased in both MHC I (young: −29 % from 221 ± 11 μM; old: −19 % from 243 ± 10 μM) and IIa (young: −23 % from 204 ± 12 μM; old: −32 % from 211 ± 21 μM). Correspondingly, SF decreased in both MHC I (young: −18 % from 75.3 ± 4.0 kN/m^2; old: −8 % from 77.0 ± 3.1 kN/m^2) and IIa (young: −22 % from 117.3 ± 6.1 kN/m^2, old: −20 % from 117.4 ± 7.9 kN/m^2). After recovery, myosin content returned to baseline levels in MHC I (young: 255 ± 14 μM; old: 244 ± 14 μM). Similar observations occurred for MHC IIa in old (225 ± 20 μM), whereas a higher level was reached in young (269 ± 22 μM). The observed changes in the old were larger for MHC IIa versus I fibers.

In conclusion, 14 days of disuse decreased single fiber myosin content in both young and old (in particular for MHC IIa fibers), which in part explained the observed decreases in SF. Twenty-eight days of active recovery fully re-established myosin content in both young and old.

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Effects of anabolic steroid on nuclear number and muscle mass

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Anabolic steroids (AS) is a potent drug that increase muscle mass and it is widely misused by athletes because of its performance enhancing effects. In previous studies we have demonstrated that nuclei number after overload does not decrease after periods of inactivity. The aim of this study was to investigate if AS treatment lead to increase in number of nuclei and if previous use of anabolic steroids promotes muscle growth at a later time point.

Pellets containing AS or placebo were implanted subcutaneously in female NMRI mice. Mice were treated for 14 days before pellets were removed. After subsequently 21 days 2/3 of m.tibialis anterior were removed to induce overload on m.EDL for 14 days. For measurements of cross sectional area (CSA) and counting of myonuclei, cryosections were stained with anti-dystrophin and DAPI. Analyzes were also preformed by in vivo intracellular injections.

Treatment with AS for 14 days leads to an increase in the CSA and the number of nuclei. The new nuclei seemed to be retained, even during subsequent removal of AS. The higher number of nuclei also seemed to facilitate muscle hypertrophy during overload.

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Tropomyosin flexibility modulates Ca^{2+} sensitivity of thin filament and affects tension relaxation in skeletal muscle myofibrils after troponin-tropomyosin removal and reconstitution

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Tropomyosin (Tm) is a coiled-coil alpha-helix regulating the cooperative activation of muscle contraction by the thin filament. Tm forms strands along actin filaments which azimuthally move between switched-on/off locations under the influence of Ca^{2+}-troponin (Tn) and strong crossbridge formation. The flexibility of Tm strongly influences its movement so that the relaxation-activation mechanism within the thin filament may be critically modulated. We studied the mechanical consequences of the presence of chicken recombinant alpha tropomyosin, D137L, in rabbit skeletal muscle myofibrils, previously characterized in vitro. Endogenous Tm and Tn were replaced into rabbit skeletal muscle myofibrils with recombinant rabbit Tn (WT) and chicken alpha Tm (WT and L137D). Tm-Tn replacement was about 90 % (SDS-PAGE). Force recordings from small bundles of myofibrils show that at saturating Ca^{2+} (pCa 4.5), maximal tension was not affected by Tm flexibility nor were the rates of force activation (k_{ACT}) and force redevelopment (k_{TR}). Interestingly, D137L Tm decelerates the rate of the fast phase of myofibril force relaxation. This is likely related to the higher "Ca^{2+}-independent" tension observed in the D137L replaced myofibrils and then to the presence of some myosin heads able to cycle in the absence of Ca^{2+}, resulting into slower relaxation and higher "resting" tension. Moreover, at submaximal Ca^{2+} (pCa 5.9), the presence of D137L Tm significantly increases (about 15–20 %) both force and kinetics of force generation. Consistently, force-pCa curves obtained from myofibrils replaced with D137L Tm showed a 0.15 increase in pCa compared to WT and an increased apparent cooperativity.

These results suggest that the presence in the sarcomere of D137L Tm could increase fractional occupancy of the thin filament Open State without Ca^{2+} (stronger affinity for Ca^{2+} than to the Blocked state) together with an increase in the cooperative unit size expected from a decrease in Tm flexibility. This result supports the hypothesis that the increased flexibility imparted to the Tm coiled–coiled structure by Asp at 137 avoids excessive turning–on of the system at the high physiological myosin concentrations.

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Increased intramuscular connective tissue in sarcopenia: influence on muscle specific force

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The causes of reduced in vivo specific force (SF) in skeletal muscle weakness in old age has not been well characterised in humans. In young (22 ± 1 years) and older (72 ± 1 years) men ($n = 36$) and women ($n = 35$) we measured quadriceps in vivo SF as: (maximal torque/patellar tendon moment arm)/quadriceps physiological cross sectional area (PCSA) * the cosine of the fibre fascicle pennation angle. Data are reported as mean ± SEM.

Compared with young, the older subjects were 37 % weaker (246.5 ± 11.7 vs 156.2 ± 7.1 Nm in young and old, respectively); PCSA was 27 % lower (204.5 ± 7.3 vs 149.6 ± 5.9 cm^2 in young and old, respectively), and SF was 17 % lower (Fig. 1; all $P < 0.0005$). The relative reduction in SF was similar in men and women. Muscle biopsy samples showed similar fibre-type composition and type I fibre