NEUROMUSCULAR ADAPTATIONS TO STRENGTH TRAINING IN OLD AGE.

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Introduction

The purpose of this study was to assess the alterations in the neuromuscular properties of the triceps surae muscle group following 12 month strength training in elderly men.

Methods

20 healthy, community-dwelling elderly men volunteered to participate in this study. The subjects were randomly assigned to either a training group (TRAIN: n=14, age: 73.3 ± 3.4 years (range 70-82), height: 169.9 ± 4.8 cm, mass 77.0 ± 7.3, mean ± SD) or a control group (CON: n=6, age: 74.3 ± 4.5 years (range 69-82), height: 170.0 ± 3.0 cm, mass: 71.9 ± 4.2 kg). The 12 months training programme consisted of two sessions per week resistance training (2-3 sets, 8-10 reps of 8RM; Technogym equipment) with aerobics, stretching and tai-chi under supervision and one home based session per week using Therabands. Measurements were conducted prior to and post the 12 months period. Plantar flexor maximal voluntary isometric strength (MVC) was measured using a Cybex dynamometer with the ankle at the optimal angle of -20 degrees (ankle in dorsiflexion) and at 0 degrees (neutral) with the subjects lying prone (knee at 180°). Maximal concentric and eccentric isokinetic strength of the plantarflexors was measured at 50, 100, 150, 200 and 250 degrees.s^{-1}, from which maximal power was calculated (2). Supramaximal double electrical pulses were superimposed on MVC and elicited 1.5 s post MVC at rest to determine percent voluntary activation level (1). Co-activation of the tibialis anterior (TA) was determined from integrated EMG (ratio of maximal TA iEMG activity during PF MVC to maximal TA iEMG during dorsiflexion). Magnetic resonance imaging was used to assess triceps surae (TS) muscle volume (soleus, medial and lateral gastrocnemius muscles). Specific torque of the TS was calculated as the ratio between the maximal torque of -20 degrees and muscle volume. This has previously been shown to approximate force per physiological CSA (3).

Results

MVC increased in the TRAIN group by 20.1% ($P<0.00$) from 112.6 ± 6.3 to 140.5 ± 5.0 Nm (mean ± SE) following 12 months, whereas the CON observed a non-significant increase (100.6 ± 5.6 to 110.3 ± 8.1 Nm). The activation capacity of the TRAIN group increased after training from 84.4 ± 3.0% to 91.9 ± 2.1% ($P<0.01$) with no change in the CON group (74.1 ± 4.9 to 77.0 ± 5.1%). No change in co-activation levels were observed in either group after 12 months. TS muscle volume increased over the 12 month period in both groups, with the greatest increase observed in the TRAIN group (increase of 199.0 ± 23.4 cm^3 compared to 74.7 ± 23.4 cm^3 in CON). Specific torque tended to increase in the TRAIN group (142.2 ± 9.2 to 156.1 ± 7.9 kN.m^{-2}, ns) with no change in the CON (136.0 ± 5.8 to 135.4 ± 7.9 kN.m^{-2}), as shown in Figure 1. Maximal power of the TS increased in the TRAIN group by 44.0 W.cm^{-3} ($P<0.01$) with only a modest increase (13.8 W.cm^{-3}) in the CON group following 12 months.

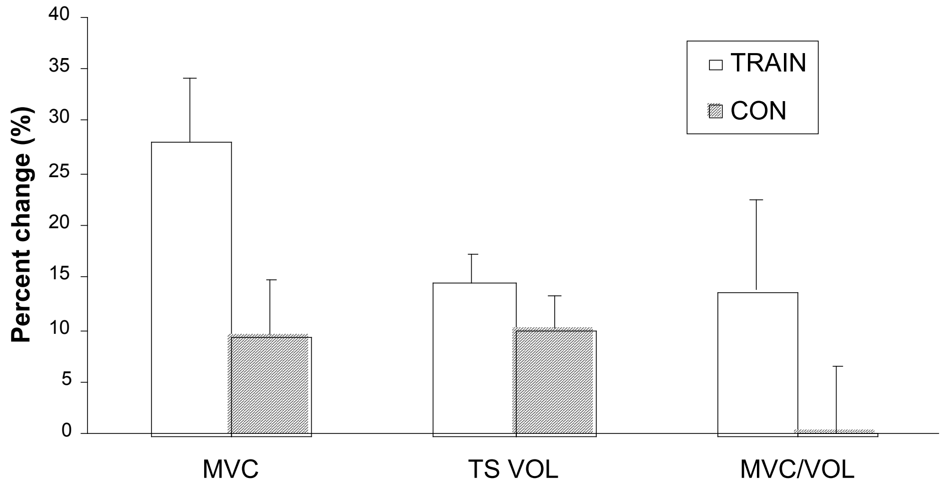

Figure 1: Percent changes pre to post 12 months in strength training group (TRAIN) and control group (CON) in plantarflexor MVC, TS volume, and specific torque (MVC/VOL).

Conclusion

The present study has shown that strength training in old age is very effective in recovering strength and power. Training not only proves effective in preventing sarcopenia but improves the ability of older people to voluntary activate their locomotor muscles. Such adaptations are most important for maintaining mobility and independence in old age.

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Bibliography

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