ISOMETRIC TRAINING ALTERS MECHANICAL PROPERTIES OF TENDON STRUCTURES.

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INTRODUCTION

The mechanical properties of tendon structures are related to the functional characteristics of muscle-tendon complex (MTC), such as the rate of torque development (RTD) and electromechanical delay (EMD) [1]. On the other hand, resistance training changes the tendon tissues to be stiffer [1, 2], which could result in faster RTD and shorter EMD.

The present study aimed to examine the effect of isometric resistance training on elastic and functional properties of human elbow flexor muscles.

METHODS

Nine healthy males (age, 24.4±2.3 years; heights, 172.8±6.7cm; weight, 68.1±8.9kg; mean ± SD) voluntarily participated in this study. They were requested to perform maximal isometric elbow flexion torque at 90° of elbow joint for ten seconds, five times a day (interval between trials was one minute each), five days a week, for six weeks. Before and after the training period, the distal myotendinous junction of the biceps brachii (MTJ) was visualized on the real-time ultrasonic image (Aloka SSD6500). Excursion of the MTJ during ramp isometric elbow flexion was considered as the elongation of the tendon structure. Maximal isometric elbow flexion torque (MVC), RTD, EMD and muscle thickness of elbow flexors were measured before and after the training period. RTD was determined as the rate of torque increase from 0 to 50% MVC. EMD was calculated as the time interval between the onset of electromyogram and torque development.

RESULTS AND DISCUSSION

The relationships between the tendon elongation (L) and tendon force (F) before and after the training period are shown in Fig 1. Before the training, the L-F curve consisted of two phases, i.e., phase 1 (Ph1), the region below 40%MVC of force with a large tendon elongation, and phase 2 (Ph2), the region above 40%MVC. The training changed the point

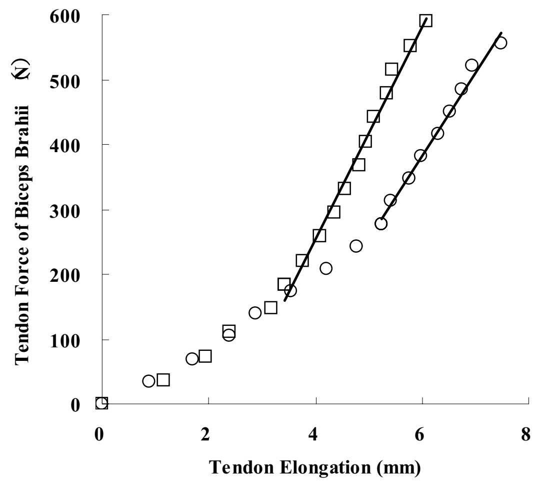

Figure 1: The relationship between tendon elongation and %MVC before (○) and after (□) the training.

dividing Ph1 and Ph2 from 40%MVC to 25%MVC. The decrease of tendon elongation in Ph1 may be related with a decreased slack of tendon or joint laxity. The slope of the regression line for the relationship between L and F in Ph2, representing the tendon stiffness as reported previously [1, 2, 3], increased significantly after the training. There were tendencies for RTD to increase and EMD to decrease by the training, which could be attributed to less tendon elongation at the lower force region. However these changes were not significant (Table 1).

REFERENCES

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Table 1: Measured variables before and after the training.

	Berofe the training		After the training	
MVC (Nm)	62.01±6.09		65.79±7.03	
Muscle thickness (mm)	32.12±2.02		32.47±2.71	
EMD (ms)	35.33±6.30		30.78±3.80	
RTD (Nm/s)	537.75±147.46		578.80±220.30	
	Phase1(0-40%MVC)	Phase2 (40-80%MVC)	Phase1 (0-25%MVC)	Phase2 (25-80%MVC)
Tendon elongation (mm)	5.24±1.64	7.22±1.69	3.42±1.89	6.07±2.43
Slope of regression equation (N/mm)	53.91±16.64	130.95±35.08	41.79±40.66	174.05±113.98 *