Torque-velocity characteristics and contractile Rate of Force Development in elite badminton players

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Introduction
Badminton at the elite level places a high demand on both the aerobic and anaerobic systems for energy delivery during play and recovery. Several times during the game explosive bursts of muscle activity are performed, e.g. a quick lunge and return to the start or move off in another direction. Thus, badminton at the elite level requires appropriate levels of muscular endurance, maximal muscle strength and explosive muscle strength. In the present study we examined various strength parameters of 35 male elite badminton players compared to an age-matched reference group that were physically active on a recreational basis. Furthermore the badminton players were compared to the same reference group that had been doing resistance training for 14 wks.

Methods
35 male Danish elite badminton players (23.5 +/- 3.5 yrs, 185.5 +/- 7.7 cm, 79.1 +/- 7.2 kg) participated in the present study. Among the group were participants from the Olympics 2004 and the 2002-2004 World Championships. 35 healthy young age-matched males that were physically active on a recreational basis were recruited as a reference group (23.2 +/- 1.9 yrs, 182.6 +/- 7.3 cm, 76.2 +/- 9.0 kg). The reference group went through 14 wks resistance training (3/wk, 4 sets/exercise, 6-12 RM) for the lower body (leg press, knee extension, hamstring curls) and was compared to the badminton players again. Maximal muscle strength of the knee extensor and flexor muscles was determined using isokinetic dynamometry (KinCom). To measure explosive muscle strength the contractile rate of force development (RFD) was determined during a maximal isometric muscle contraction.

Results
During the isokinetic quadriceps and hamstring muscle test the badminton group showed 11-16 % higher knee extensor and flexor torque compared to the untrained group. After 14 wks of resistance training in the previously untrained group quadriceps muscle strength increased at the slow contraction velocities to levels that were similar to those observed in the badminton players (Fig.1). The badminton group were significantly stronger than the resistance trained group only at fast (240°s⁻¹) concentric quadriceps contraction (Fig. 1). H/Q-ratios were similar in the groups. Quadriceps contractile RFD was 9-21 % higher in the badminton players compared to the reference group (P<0.001-0.05). Likewise, hamstring contractile RFD was 19-40 % higher in the badminton players compared to the reference group (P<0.001-0.01) (Fig. 2).

Discussion/Conclusion
Generally the badminton players showed greater levels of maximal muscle strength and contractile RFD compared to the reference group. However, after 14 wks resistance training the reference group achieved similar levels of isometric and slow concentric muscle strength compared to the badminton players. Large volumes of concurrent endurance training may have inhibited long-term muscle strength development in the badminton players (Hickson, 1980). The badminton players showed higher levels of contractile RFD compared to the reference group before and after resistance training. Higher levels of explosive muscle strength in the badminton players may be a physiological adaptation to the badminton training per se.

References