

BWF Sports Science Research Projects 2017-18; Submission of final report

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Project title: Changes in explosive strength after badminton match play and relationships with injury

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EXTENDED ABSTRACT

Introduction: Success in badminton requires the ability to produce repetitive bursts of explosive efforts during on-court movements (i.e., quick lunge and return to the start or move off in another direction), characterised by high levels of muscle force/torque production within the initial phase of contraction. To date, however, muscle strength evaluation in badminton players (as in other racket sports) is mainly concerned with torque produced during maximal voluntary contractions. The aim of this study was to assess the time course of changes in maximal and rapid muscle torque production capacity of plantar flexors (PF) and dorsi flexors (DF) in response to badminton match play.

Methods: Maximal torque and rates of torque development (RTD) from 0 to 30, 0-50, 0-100, 0-100 and 0-200 ms were recorded during three maximal (3–5 s; “*as hard as possible*”) and three explosive (<1 s; “*as fast as possible*”) isometric voluntary contractions of the PF and DF (separated by ≥ 20 s), respectively. These values were obtained in sixteen juniors (10 males, 6 females), International-level badminton players before (pre-match), in-between (mid-match) as well as immediately (post-match) and 12 h (+12 h) after 70-min (2 \times 35 min, 15 min of rest) badminton single matches.

Results: For both PF and DF, maximal torque decreased from pre-match to mid-match ($-6.1\pm 10.0\%$ and $-8.2\pm 6.1\%$; $P=0.117$ and $P<0.001$) and post-match ($-9.5\pm 9.8\%$ and $-7.2\pm 5.4\%$; $P<0.001$ and $P=0.013$), but returned near baseline after 12 h. Compared with pre-match, PF RTD decreased at mid-match ($-13.3\pm 30.0\%$, $-10.4\pm 21.1\%$, $-9.0\pm 11.3\%$, $-5.0\pm 10.2\%$ and $-3.6\pm 11.5\%$ at 0-30, 0-50, 0-100, 0-150 and 0-200 ms; all $P<0.05$) and was further reduced, during early time intervals only ($-25.2\pm 22.9\%$, $-21.4\pm 20.1\%$ and $-14.9\pm 10.5\%$ at 0-30, 0-50 and 0-100 ms; all $P<0.001$), at post-match. A similar reduction in DF RTD occurred at mid-match and post-match (ranging $-27.3\pm 16.7\%$ to $-7.5\pm 6.9\%$ and $-27.6\pm 14.4\%$ to $-3.0\pm 7.9\%$ within the 0-30 to 0-200 ms epoch after contraction onset, respectively; all $P<0.05$) relative to pre-match. Reductions in RTD for both PF and DF were fully restored after only 12 h of recovery. RTD DF/PF torque ratios during the very initial phase of contraction (up to 50 ms from onset) were lower compared to the MVC DF/PF torque ratio, with no effect of time (all $P<0.05$).

Discussion:

- In PF and DF, decrement in explosive muscle strength are generally twice larger than in maximal strength, with most of adjustments already seen at mid-match.
- Decrements in absolute RTD were more visible during early than late contraction phases. When interpreting fatigue-induced changes in rapid muscle torque production characteristics in response to match-play badminton, alterations in contractile rates of torque development should be analysed using values obtained in the early phase (< 100 ms) of the rising muscle contraction.
- Under fatigue, early-phase (0-100 ms) contractile RTD values in both PF and DF remained lower after normalization to MVC, indicating that the physiological mechanisms underlying maximal and explosive strength during early contraction phase are not completely shared.
- Maximal and explosive strength returned near baseline after only 12 h of recovery. From a neuromuscular perspective, in a tournament scenario, playing matches on consecutive days may not negatively affect players' ability to produce optimal levels of both maximal and explosive torque in the ankle muscle groups.
- With unaltered explosive or maximal ratios, fatigue induced by badminton match play doesn't seem to reduce the potential for ankle joint stabilization during the initial phase (first 200 ms) or peak phase of voluntary muscle contractions.
- When designing rehabilitation (injury prevention) and resistance training (performance improvement) programs targeting the ankle joint of badminton players, rapid muscle torque production characteristics obtained in the early phase of the rising muscle contraction should be prioritized.

Conclusion: Badminton decreases more rapid than maximal muscle torque production capacity of the plantar flexors and extensors. Because explosive torque indices are more sensitive (especially during < 100 ms time intervals) than ‘traditional’ maximal torque production capacity measurements we recommend their inclusion to more accurately reflect acute fatigue induced by a badminton match.

Key words: Badminton, Plantar flexors; Dorsi flexors; Explosive strength; Antagonist/agonist strength ratio; Fatigue; Recovery; Injury risk.

