Monitoring post-match lower-limb recovery in elite Australian Rules Football using a groin squeeze strength test

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Headline

Monitoring the post-match recovery time course of players' fatigue and readiness is paramount to optimize training schedule and contents the first days following competition. Many variables can be monitored in practice, being indicative of psychological (e.g., wellness), biological (e.g., creatine kinase) and more importantly neuromuscular (e.g., maximal voluntary contractions, jump tests) status (1). Nevertheless, assessing neuromuscular fatigue often requires sophisticated and costly devices (e.g., isokinetic machines, force plates), which limits their use in the field. Monitoring groin squeeze strength using simple and cheap (<1000 USD) dynamometers or sphygmomanometers may be a relevant alternative (2-5). However, whether groin squeeze strength testing is sensitive to match-related lower-limb fatigue in elite football is unknown.

Aim. The aim of the present study was to examine the 1) reliability and 2) recovery time course of groin squeeze strength following an official competition in Australian Football League (AFL) players. Comparing the magnitude of match-related changes in groin squeeze strength with its typical error (i.e., signal-to-noise ratio) would shed light into its potential sensitivity, and in turn, its usefulness as a monitoring tool.

Methods

Athletes. Forty-one highly-trained senior AFL players (age: 24.2 ± 4.3 yrs, body mass: 86.2 ± 9.8 kg and 41.2 ± 5.1 mm for the sum of 7 skinfolds) participated in the study. These data arose as a condition of player monitoring in which player activities are routinely measured over the course of the competitive season (6); therefore, ethics committee clearance was not required. The study conformed nevertheless to the recommendations of the Declaration of Helsinki.

Design. Single-group, repeated trials. For the reliability analysis, groin squeeze strength was collected in-season during 8 successive weeks (2 days post game) with a stable training/competitive load (session rate of percieved exertion load: 2202 ± 666 A.U.). For the recovery time-course analysis, data were collected in 12 players before an official game (playing time 99.3 ± 3.9 min, total distance: 12455 ± 1074 m including >1720 ± 760 m >18 km/h) and the four following days at the same time of days. Players didn't train on D+1 (recovery day including stretching and hydrotherapy) but took part in their usual training session on D+2 ('flush day' with steady state active recovery and stationary skill including low volume and intensity kicking), D+3 (light skills with minimal speed or change of direction) and D+4 (main skills with controlled match simulation and other skill drills).

Methodology. Groin squeeze strength was measured with players lying on a massage table, feet flat and knees bent at 90° (Sphygmomanometer, Welch Allyn DS66 Aneroid, Perth, WA Australia). Measures were taken before training/match. Players were asked to squeeze maximally for 5-7 seconds. Following a short rest, a second trial was performed. The highest value was recorded (7).

Analyses

Data in the text are presented as means with 90% confidence limits (CL); means and standard deviation in Fugure1. All data were first log-transformed to reduce bias arising from non-uniformity error. The reliability of groin squeeze strength was assessed using the typical error of measurement (TE), both standardized (Cohen's d principle) and expressed as a coefficient of variation (CV, 90% CL), as well as the intraclass correlation coefficient (ICC, 90% CL) (8). Between-days standardized differences in the change in groin squeeze strength were compared to the smallest worthwile change (SWC, 0.2 multiplied by the pre-match between-subject deviation, based on Cohen's d principle, i.e., 4%) using magnitude based inferences. For all comparisons, pre-match performance was used as a co-variable. These probabilities were used to make a qualitative probabilistic mechanistic inference about the true effect: if the probabilities of the effect being substantially positive and negative were both >5%, the effect was reported as unclear; the effect was otherwise clear and reported as the magnitude of the observed value. Threshold values for standarized difeerences were >0.2 (small), >0.6 (moderate), >1.2

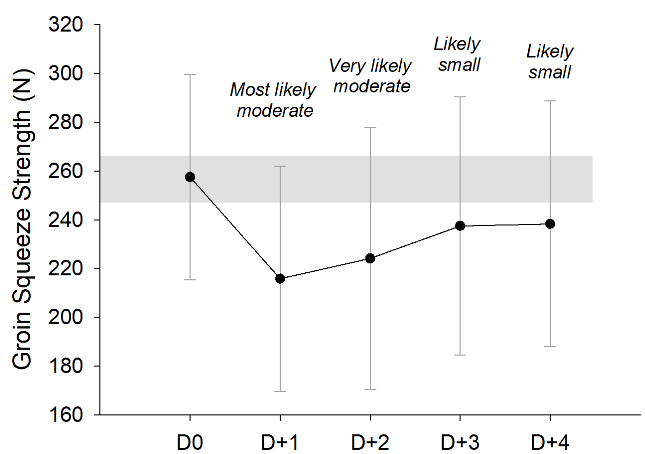

Fig. 1. Changes in groin squeeze strength (mean ± SD) following an official match in elite senior AFL players (n = 12). Grey bar: smallest worthwile change.

(large) and very large (>2) (9). The magnitude of the ICC was assessed using the following thresholds: >0.99, extremely high; 0.99-0.90, very high; 0.90-0.75, high; 0.75-0.50, moderate; 0.50-0.20, low; ¡0.20, very low (WG Hopkins, unpublished observations).

Results

The magnitude of the TE (7.6%, 6.9 to 8.5) was moderate (0.39; 0.35 to 0.43) and almost twice greater than the SWC (i.e., 4%). The ICC was rated as high (0.86, 0.80 to 0.90). Groin squeeze strength was very likely moderately decreased (-17.4%, -23.4 to -11.0) the day following the match (D+1), and remained likely slightly lower on day 4 (Figure 1)

Discussion

The moderate TE and the high ICC observed in the present study were comparable to those previously reported in other populations (i.e., CV ∼3-5% and ICC ∼0.9 (2-4)). The fact that the TE (∼8%) that was twice greater than the SWC (4%) would suggest a limited usefulness (i.e., when TE > SWC (10)). The magnitude of the TE was however still 2.5 time smaller than the match-induced decrease in groin squeeze strength (18%), suggestive of a good signal-to-noise ratio. Logically, this 18% post-match decrease was also clearly greater than that reported both in young soccer players immediately after speed (-8%) and strength (-12%) conditioned sessions (3) and in young rugby players after a match (trivial change) (4). These differences are likely related to the greater running demands of the AFL match compared with the soccer sessions and rugby match (i.e., >1720 ± 760 m for the AFL match m vs. 50-400m of high-speed running (>18-19 km/h) for soccer sessions (3) and the rugby game (4)). Another important finding of the present study is that groin squeeze strength didn't recover at D+4 (likely small difference, Figure 1). Whether players would be recovered for the next match (at D7) could not be examined. Nevertheless, this slow recovery time course was similar to that reported for various fatigue-related measures including perceived fatigue and soreness, creatine kinase and jump performance, which were not all fully recovered 96 h post-match (11). Taken together, present data show that the magnitude of groin squeeze strength decrease following intense training sessions and matches may be at least equal or more likey greater than its TE, showing its usefuless to monitor neuromuscular recovery at the individual level.

Practical Applications

- Despite a moderate level of reliability, groin squeeze strength is sensitive to training and match-induced fatigue (signal-to-noise ratio: ∼1 to 2.5), as long as training/match load includes a large high-speed running/strength component.
- Practitioner can monitor post-match individual groin squeeze strength recovery using a light, portable and cheap device such a hand held dynamometer or a phygmomanometer.
- Following a full competitive match, AFL players likely need more than 4 days to fully recover their groin squeeze strength.

Limitations

- The recovery-time course observed within the 4 days following the match may have been influenced by training contents at D+2 and D+3 – however, examining the time course of neuromuscular recovery throughout rest days has little value for practitioners.
- The limited sample size prevented the analysis of groin squeeze strength recovery as a function of player's locomotor profiles and/or age, which may be important modulating factors of the recovery responses (12). This should be the topic of further research.

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Dataset

Dataset available on SportPerfSci.com

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