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Original Article

Strength, power and opto-acoustic reaction during off-season period in professional rugby players

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Abstract:
The purpose of this paper is to highlight the degree of physical deconditioning after temporary reduction of exercise training volume and intensity in professional rugby players.
Material and methods: 27 professional rugby players (age between 18 to 32 years) were tested to determine explosive force and power of the lower limbs by performing the Counter movement jump test (CMJ) and Complex acoustic reaction test. All tests were conducted at the beginning and at the end of the off-season period (4 weeks break period). During off-season period, rugby players have temporarily reduced their exercise training volume (by 50% to 65%) and intensity (by 50% to 70%).
Results: After 4 weeks reduction of exercise volume and intensity, we recorded significant decrease ($p=0.018$) of explosive force (from 25.55±3.35 N/kg to 23.17±3.14 N/kg). Explosive power also decreased (from 45.61±9.06 W/kg to 42.35±6.19 W/kg), but the results was not statistically significant ($p=0.191$). Opto-acoustic reaction time significantly increased (from 1.34±0.07 s to 1.41±0.06 s, $p<0.001$). **Conclusions**: Off-season period due to temporary reduction of exercise training volume and intensity leads to physical deconditioning of the professional rugby players, offering a lower yield at the beginning of the season and an increased risk of injury.
Key Words: rugby players, physical deconditioning, off-season

Introduction

Rugby game is demanding players to participate in frequent bouts of intense activity (sprinting, physical collisions, and tackles) separated by short bouts of low intensity activity (walking, jogging) (Meir R., 1993; Gabbet T.J., 2002). As a result, rugby league players must draw upon several fitness components including muscular power, speed, agility, and aerobic power (Meir R., 1993; Brewer J., 1994; Gabbett T.J., 2000).

Muscular power training enables an athlete to apply the greatest amount of their maximal strength in the shortest period of time. Most athletic activities involve faster movements and higher power outputs than are found in maximal strength exercises (Scott A.C., 2003; Baker D., 2001). An athlete can be exceptionally strong but lack significant explosive power if they are unable to apply their strength rapidly.

In terms of speed, a fast athlete can not only accelerate and move in multiple directions rapidly, they should also have the ability to repeat rapid movements with minimal loss of speed. In multi-sprint sports, players are often required to repeat several high intensity runs, all-out sprints and sharp changes in direction without rest. Resistance training may suffer a complete break. This is particularly the case for athletes who spend a great time lifting heavy weights such as rugby players. Whether the resistance exercises are incorporated into the off-season training period or not, strength training should focus on compensation work involving muscle groups that receive little attention during the preparatory and competitive phases (Baker D., 1999).

If athletes do not perform an optimal training during break their condition may deteriorate. After four weeks without training, muscle capillarisation returns to pre-training baseline but remains above that found in sedentary individuals (Mtljika I., 2000). Arteriovenous VO2 difference has been found to decrease by 8% and this is suggested to result in a 9% decrease in max after 3-12 weeks without training (Mtljika I., 2000). Muscle cross-sectional area decreases and fiber-type appears to return to genotype after detraining with an increase seen in oxidative fibers versus glycolytic fibers and a decrease of 15% seen in the proportion of slow twitch fibers (Hakkinen K., 1986). A large change from fast twitch IIa to IIb has also been found in endurance runners and cyclists with training cessation (Mtljika I., 2000; Godfrey R.J., 2005).

Training for competitive rugby requires year□long training in all aspects of physical performance. Throughout the training cycle, there will be periods where the athlete will be away from the home facility, coaches and medical staff and could reduce training volume or intensity without continual supervision. This period is not usually designed for competitive tournaments, yet substantial training is still planned and expected. (Mark S. Kovacs, 2007)

We could argue that off-season training is an important phase of any sport-specific conditioning plan. It helps the athlete to recover physically and psychologically. When the training stimulus is removed, physiological

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adaptations begin to reverse back to pre-training levels. This can quickly lead to detraining. The key then, is to find a balance between recovery and the maintenance of fitness. As long as the off-season training period is no longer than 4-5 weeks, the athlete can be refreshed without losing most or his level of conditioning.

The purpose of this paper is to highlight the degree of physical deconditioning after temporary reduction of exercise training volume and intensity in professional rugby players.

Material & methods

The study included 27 professional rugby players (age between 18 to 32 years). During off-season period, rugby players have temporarily reduced their exercise training volume (by 50% to 65%) and intensity (by 50% to 70%). The amount of reduction was investigated using a questionnaire by a third person (not involved in the training team, and blind to the study purpose). All tests were conducted at the beginning and at the end of the off-season period (4 weeks break period). Players were instructed to wear the same footwear for all testing sessions. The testing procedure and time of the day was identical for all participants. No training took place 24 h prior to each test in order to minimize the effects of fatigue on test results.

The level of performance in the leg muscles (explosive force and power):

All subjects underwent measurements of explosive force and power of the lower limbs by performing the Counter movement jump (CMJ) test using Myotest system. After the initial familiarization session, testing took place on a wooden, indoor floor surface to control for environmental conditions such as temperature, wind and ground conditions. Explosive force and power have been recorded following a predetermined protocol using an accelerometer placed at the pelvis. CMJ test is based on a total of five jumps to a height as high as possible, with hands positioned at the hip, starting from a standing position. After performing five jumps, the device records the parameters of the best jumping.

Opto-acoustic reactivity test:

The complex reaction was assessed in each subject by making a move outside a perimeter and reaching a target located at a distance of 1 meter from the area, and at 20 cm from the floor, when the device launches randomly an acoustic or visual signal. Followed by a video camera and optical sensors, subject begins with both feet inside of the perimeter. Right after the signal, the subjects steps out to the right of the perimeter in order to reach the target. Thereafter, the subject returns in the starting position and awaits the next signal. At the launch of the second signal, subject performs the same movements, but on the other side. (Fig. 1) That was repeated 5 times and Optojump system records the average reaction speed of the subject.

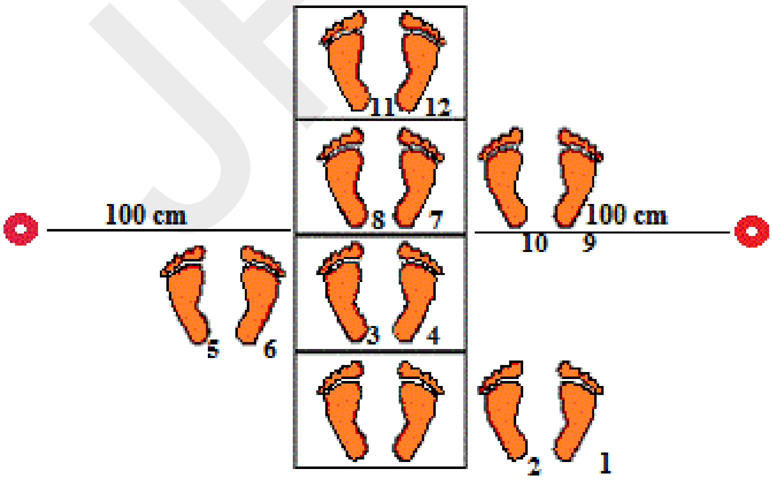

Figure 1. Testing protocol of opto-acoustic reactivity

Statistical analysis:

Continuous variables are presented as mean and standard deviation. Change from baseline to follow-up within the group was tested using paired t-test. The level of statistical significance was set at p≤0.05. Statistical analyses were performed with the help of "GraphPad Prism v.5" software for Windows.

Results

After temporary reduction of exercise volume and intensity of the rugby players, we recorded significant decrease (p=0.018) of explosive force (from 25.55±3.35 N/kg to 23.17±3.14 N/kg). Explosive power also decreased (from 45.61±9.06 W/kg to 42.35±6.19 W/kg), but the results was not statistically significant

(p=0.191). Opto-acoustic reaction time significantly increased (from 1.34±0.07 s to 1.41±0.06 s, p<0.001). (Table I, Figure 2-4)
The subjects drop out rate from the study was 11%, three players didn't participate in the final evaluation.
Table I. Mean values of the parameters recorded at baseline and after 4 weeks of study

Parameter	Baseline	After 4 weeks	p
Explosive force (N/kg)	25.55±3.35	23.17±3.14	p=0.018
Explosive power (W/kg)	45.61±9.06	42.35±6.19	p=0.191
Opto-acoustic reaction time (s)	1.34±0.07	1.41±0.06	p<0.001

Values are presented as mean ± standard deviation.

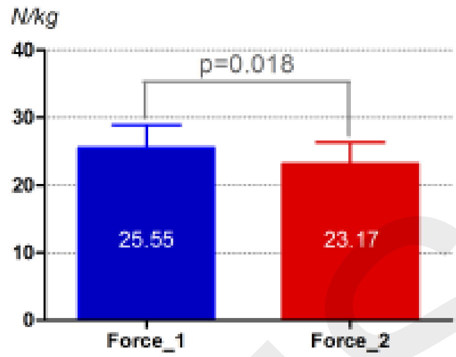

Figure 2. Trend of explosive force after temporary reduction of exercise volume and intensity.
Force_1: explosive force at baseline; Force_2: explosive force after 4 weeks of exercise volume and intensity reduction.

Figure 3.Trend of power after temporary reduction of exercise volume and intensity.
Power_1: explosive power at baseline; Power_2: explosive power after 4 weeks of exercise volume and intensity reduction.

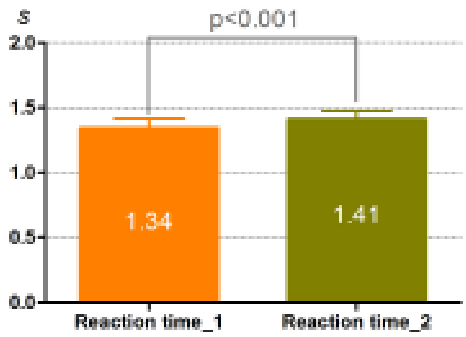

Figure 4.Trend of opto-acoustic reaction time after temporary reduction of exercise volume and intensity.
Reaction time_1: opto-acoustic reaction time at baseline; Reaction time_2: opto-acoustic reaction time after 4 weeks of exercise volume and intensity reduction.

Discussion

Study results show that off-season temporary reduction of exercise training program significantly decreased the lower limbs muscular performance of the professional rugby players. This is making difficult the return to the previous level of muscular performance and to improve it for the next season.

The results are in agreement with a recent study which investigate seasonal variations in physiological fitness of semi-professional soccer players over a 12-month period and found that significant deconditioning was apparent in all fitness variables from end of season to preseason training of the next season (Caldwell, B.P. 2009).

Louis J Holtzhausen et al, in his study (December 2006, Vol. 96, No. 12, SAMJ) concluded that injuries tended to occur early in the season, suggesting lack of physical conditioning as possible causes of injury. This proves that any decrease in physical fitness expose athletes to sport injury.

Some authors suggest that during off-season period it is recommended to perform a different type of exercise or sport that sportsman wouldn't usually have the chance to (avoid the form of exercise which is performed in competition). The goal is not to reach a point of significant overload, but to maintain at least 80% of the mid-season exercise volume and intensity (Baker D., 1999).

Conclusions

Off-season period due to temporary reduction of exercise training volume and intensity leads to physical deconditioning of the professional rugby players, offering a lower yield at the beginning of the season and an increased risk of injury.

However, we need further evaluation of fitness variables in the pre-season period in order to establish the minimum amount of time needed for achieving the optimal fitness level for professional rugby players. Besides sport results, optimal fitness level is needed in order to prevent the increased rate of sport injuries in the period immediately following the start of the season.

Conflicts of interest - There is no conflict of interest.

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