INFLUENCE OF PLYOMETRIC TRAINING ON THE EXPLOSIVE POWER OF SENIOR RUGBY SEVENS PLAYERS

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Abstract. *Rugby is a team sport in which physical contact with the opponent is direct. A fundamental feature of today's rugby game indicates total physical involvement with the opponent, focusing on the contact struggle that takes place in both the individual and collective confrontation. Rugby sevens (7s) players engage in contact situations similar to rugby union and rugby league, such as tackling, rucking, carrying the ball into contact, mauling and scrummaging, which require strength and explosive power. Since plyometrics can significantly improve speed, strength and explosive power, this type of training can be recommended for rugby players. The present research was conducted on a group of 20 senior rugby players, professional athletes of the CS Politehnica Iași Women's Rugby 7s team. The purpose of the research was to implement an eight-week programme (with two sessions per week) for the development of explosive power using the plyometric method. The tests consisted of the countermovement jump, free jump and squat jump, which were applied at the beginning of the training period for the championship return and at the end of the championship. The test results were entered into the SPSS (version 23) database, processed and analysed with the bilateral dependent t-test to compare the results. The study shows that plyometrics can be an effective training method to improve the explosive power of rugby sevens players. In conclusion, we can say that the explosive power of the lower limbs is an essential component that conditions sports performance in the game of rugby sevens.*

Keywords: *monitoring, plyometric training, explosive power, rugby sevens.*

Introduction

Rugby is a team sport in which physical contact with the opponent is direct. A fundamental feature of today's rugby game indicates total physical involvement with the opponent, focusing on the contact struggle that takes place in both the individual and collective confrontation (Sarthou, 2010).

Rugby sevens (7s) players engage in contact situations similar to rugby union and rugby league, such as tackling, rucking, carrying the ball into contact, mauling and scrummaging, which all require strength and explosive power (Duthie et al., 2003). While numerous studies (Argus et al., 2012; Smart et al., 2011; Crewther et al., 2011) have addressed the topic of strength and power in rugby union players, there is a dearth of research reporting such data for rugby sevens players.

In rugby sevens, strength manifests differently; for example, the execution of a tackle involves sudden movements, therefore dynamic is required to develop explosive power or strength-speed (strength in conditions of speed). Any tackle needs to be executed with maximum speed because, after performing it, the player must release the opponent to get up and quickly take a defensive position regardless of the opponent's resistance, which involves the development of strength-speed at the highest possible parameters.

According to Dragnea (1992), explosive power or vertical jump power can be developed by either increasing maximum strength while maintaining the speed of execution or increasing the rate of muscle contraction speed. As a rule, the workouts aim at developing maximum strength up to a certain level, after which special speed exercises are used in order to transform maximum strength into explosive power.

Explosive power is an individual's ability to produce the greatest amount of force in the shortest time. Some specialists in the field, for instance Song and Hori (2020), believe that it depends on the age of an individual but also on the level, volume and intensity of training.

Other authors (Schettino et al., 2014; Sha et al., 2021) claim that the explosive power of the lower limbs is conditioned by the size and number of motor units involved in muscle contraction, the metabolic processes in the muscles and the density of the capillaries.

Given that jumping ability is strongly influenced by the individuals' ability to take advantage of the elastic and neural benefits of SSC, but also by their high levels of strength development and the excursion rate of the muscles activated during contraction, plyometric training is expected to be favourable for the jump performance of athletes (Çankaya et al., 2018).

The purpose of the plyometric training is to improve the strength of subsequent movements using both the natural elastic components of the muscles and tendons and the stretch reflex (Trajković et al., 2016).

In fact, the literature is consistent with suggesting that plyometric training contributes to the optimisation of landing mechanisms (Mroczek et al., 2018), the improvement of eccentric muscle control and the increase of knee flexion and hamstring activity (Bashir et al., 2018).

It has been proven that plyometric training increases the jump performance of athletes, but the planning of plyometric workouts still remains unclear (Marković, 2007; Stojanović et al., 2017). Some authors (Pyne et al., 2009; Weis et al., 2003) think that the design of plyometric programmes can be the same as the design of strength training, using periodization and based on the concepts of the training process and post-training recovery periods.

Meir et al. (2001) have shown that excess body fat negatively influences an athlete's performance (for example, the ratio of power to body mass, thermoregulation and aerobic capacity).

Body composition is an important factor in the development of an athlete, depending on muscle mass and the percentage of adipose tissue, which leads players to either achieve or not to achieve the established performance. Body fat does not contribute to producing muscle strength, and excessive amounts of body fat will affect the sprint ability.

Size and body composition are defining elements of rugby players and represent indicators that determine their specialisation (Bloomfield et al., 1994; Duthie et al., 2006). However, no studies have been found to confirm the correlation between anthropometric changes and plyometric training in team athletes.

The efficiency of plyometric training was demonstrated by Witzke and Snow (2000) in a study conducted over a period of 9 weeks, at the end of which the investigated adolescents increased their bone mass, which in turn positively influenced their muscle mass.

According to the literature (McKay et al., 2005; Linden et al., 2007), jumping and running can lead to improvements in bone mass and the cross-sectional area of athletes' muscle fibres.

The somatotype, especially the mesomorph component, can be positively influenced by the increase in the bone and muscle mass of individuals (Bolonchuk & Lukaski, 1987).

Some authors (Duthie et al., 2003; Jenkins & Reaburn, 2000) believe that the relationship between anthropometric variables and power is essential in the game of rugby, and certain changes in plyometric training can lead to long-term improvements in sports performance.

Given the relevance of power development in rugby, plyometric exercises are widely used during the physical training of rugby players, which is mainly due to the influence of this type of training on power, jump and sprint performance (Kilduff et al., 2007).

However, the influence of the amount of jumping performed during training on neuromuscular recovery has been poorly investigated so far. Several studies have shown that plyometric training improves strength, power, jump height and sprint performance.

De Villarreal et al. (2008) and De Villarreal et al. (2011) have highlighted that the volume of plyometric training has an important influence on the development of speed, jump height and power, which go beyond the level that is normally induced by training.

Ebben et al. (2010) have demonstrated that the periodic use of a plyometric programme leads to an improvement in jump height and jump strength among relatively trained female athletes, without the need to apply a recovery programme at the end of training.

Plyometrics, also known as jump training, is a method that aims to improve power production and strength rates, thus allowing the player to become more explosive (Jeffreys & Moody, 2016; Popović, 2016).

Webb and Lander (1983) state believe that the game of rugby generally requires speed, flexibility, muscular and cardiovascular endurance, agility and explosive power. Therefore, Schuster et al. (2018) advise coaches and athletes to place the focus “on running and repeated power skills, strength, and match-specific conditioning capacities” (p. 255). Since plyometric exercises can significantly improve physical and anthropometric qualities, this type of training method can be successfully recommended for rugby players.

An important factor that can determine the effectiveness or magnitude of the benefits of plyometric interventions is the duration of the training period. It was observed that the interventions implemented in the revised studies ranged from 4 weeks (Boerio et al., 2003) to 16 weeks (Fatouros et al., 2000), with the most common periods between 6 and 12 weeks. According to the revised articles, improvements of 8% and 9.2% in vertical jump were reported in two studies that used six-week plyometric training protocols. Improvements of 16.9% and 27.6% were also observed in countermovement jumps in two of the studies that included 12-week training protocols. It appears that plyometric training programmes that last more than eight weeks can be more useful in achieving significant improvements.

Methodology

The present research was conducted on a group of 20 senior rugby players, professional athletes of the CS Politehnica Iași Women’s Rugby 7s team.

The purpose of the research was to implement an eight-week programme (with two sessions per week) for the development of explosive power using the plyometric method.

The tests consisted of the countermovement jump, free jump and squat jump, which were applied at the beginning of the training period for the championship return and at the end of the championship.

During the training programme, jumping variants were used in different forms and under different conditions in order to determine the degree of difficulty pursued, which was established according to the objective of the training and the stage of training reached by the participating athletes (Table 1).

In addition to the proposed jumping options, other means of action were used with the purpose of contributing to the achievement of effective general and specific physical training, which together provided the general and specific physical training necessary to support the competitive effort.

Thus, among the methods and means of action that made up the training programme of the investigated athletes, the plyometric method, namely jumping in different forms and at various intensities, was found to be very efficient with regard to the test results obtained in the context of the current research.

Plyometric exercises were performed twice a week in order to allow sufficient recovery time between workouts, as recommended by a number of researchers (Adams et al., 1992).

Table 1. *Means of action used in plyometric training*

Means and methods	**Dosage**	**Intensity**
1. consecutive long jump continued with sprint	4 series x 6 jumps + 30 m sprint	100%
2. consecutive high jump continued with sprint	4 series x 6 jumps + 30 m sprint	100%
3. step continued with sprint	4 series x 6 steps + 20 m sprint	100%
4. jumped step continued with sprint	4 series x 6 steps + 20 m sprint	100%
5. jumped step interspersed with step continued with sprint	4 series x 6 steps + 20 m sprint	100%

The test results were entered into the SPSS (version 23) database, processed and analysed with the bilateral dependent t-test to compare the results.

The research methods used were: scientific documentation, experiment, observation, measurement, mathematical statistics and graphical method.

Results

According to Table 2, the average result decreased by 0.67 kg, from 60.06 to 59.39 kg. Verification of the statistical significance with the bilateral t-test revealed a statistically insignificant average difference, $p = 0.381 > 0.05$. Athletes' results in the final test show an insignificant decrease in their body weight.

The average body mass index decreased by 0.71 kg/m^2, from 22.63 to 21.92 kg/m^2. Verification of the statistical significance with the bilateral t-test revealed a statistically significant average difference, $p = 0.024 < 0.05$.

The average body fat (expressed as a percentage) decreased by 3.44%, from 28.98 to 25.54%. Verification of the statistical significance with the bilateral t-test revealed a statistically significant average difference, $p = 0.009 < 0.05$.

The average muscle mass (expressed as a percentage) increased by 1.96%, from 30.95 to 32.91%. Verification of the statistical significance with the bilateral t-test revealed a statistically insignificant average difference, $p = 0.051 > 0.05$.

Table 2. *Anthropometric characteristics of the investigated athletes*

Characteristics	Pre-test (n = 20)	Post-test (n = 20)	Mean difference	Bilateral dependent t-test
Weight (Kg)	60.06 ± 5.33	59.39 ± 6.53	- 0.67	t = 0.91 p = .381
Body mass (Kg)	22.63 ± 1.80	21.92 ± 1.90	- 0.71	t = 2.56 p = .024*
Body fat (%)	28.98 ± 4.64	25.54 ± 3.61	- 3.44	t = 3.08 p = .009*
Muscle mass (%)	30.95 ± 2.25	32.91 ± 3.03	1.96	t = 2.15 p = .051

* p < 0.05

According to Table 3, the average squat jump performance increased by 3.32 cm, from 36.43 to 39.75 cm. The t-test results show that the mean difference has reached the statistical significance threshold, with $p < 0.001 < 0.05$.

The average countermovement jump performance increased by 3.10 cm, from 38.29 to 41.39 cm. The t-test results show that the mean difference has reached the statistical significance threshold, with $p < 0.001 < 0.05$.

The average free jump performance increased by 3.78 cm, from 42.49 to 46.27 cm. The t-test results show that the mean difference has reached the statistical significance threshold, with $p < 0.001 < 0.05$.

Table 3. *Average results obtained by the investigated athletes*

Tests	Pre-test (n = 20)	Post-test (n = 20)	Mean difference	Bilateral dependent t-test
SJ	36.43 ± 4.51	39.75 ± 4.16	3.32	t = 7.12 p < 0.001*
CMJ	38.29 ± 4.29	41.39 ± 4.81	3.10	t = 5.10 p < 0.001*
FJ	42.49 ± 4.84	46.27 ± 4.01	3.78	t = 7.01 p < 0.001*

Note: SJ - Squat Jump, CMJ - Countermovement Jump, FJ - Free Jump; * p < 0.001 < 0.05

Figure 1 shows the graphical representation of the averages and the difference between the results obtained by the investigated players in the two return tests following the application of plyometric exercises.

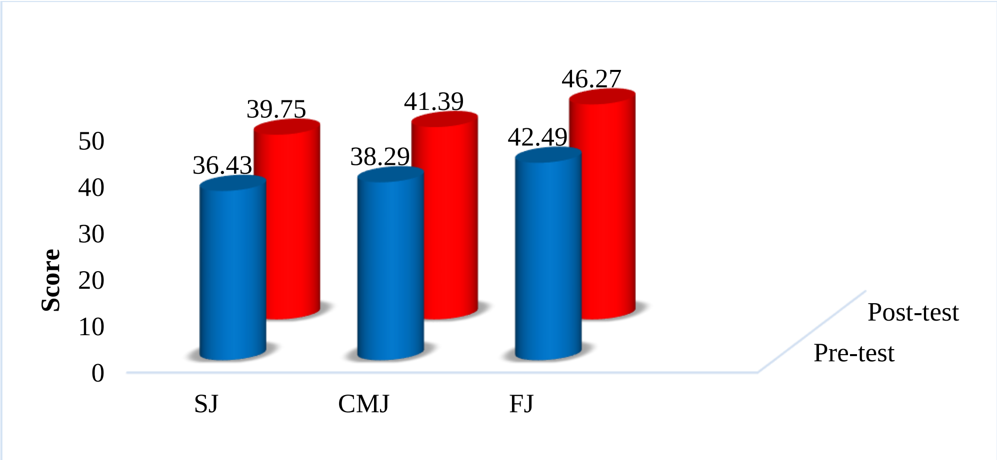

Figure 1. Average differences in athletes' test results

Conclusion

Comparing our results with those obtained in similar research studies, we have found that the use of jumping in the training programme is an effective option derived from the results obtained by the tested athletes included in the representative Women's Rugby 7s team.

Following the analysis of the literature, we have also found that the scientific support for rugby sevens is very poorly represented not only in our country but also in the European area. The theoretical scientific support of our study is based only on general information about the sports training that refers to men's rugby sevens.

One reason for this situation may also be the fact that women's rugby 7s is a relatively new sport, which is why its scientific support is currently in development.

According to specialised studies addressing other sports, the length of the training programme may vary depending on the training dosage (intensity, duration and frequency of individual sessions), the types of exercises, the sport played and the athlete's level of training.

As a result of the applied programme, a significant increase in players' elastic-explosive strength and isometric explosive power of the lower limbs can be observed in all three tests performed at the end of the intervention.

Following our study, we can say that plyometric training can be an effective method of training to improve the explosive power of a rugby 7s player.

In addition, our results suggest that explosive power improvements can occur within just 8 weeks of plyometric training, which can be useful for athletes in the last preparatory phase before the competition season.

As a conclusion, we can say that the explosive power of the lower limbs is an essential component that conditions sports performance in the game of rugby sevens.

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