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ORIGINAL ARTICLE

Acute Effects of Postactivation Potantiation on Explosive Strength Performance in Fitness Athletes

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ABSTRACT

Aim: The aim of this research is to examine the effects of postactivation potantiation (PAP) on explosive strength performance in terms of the rest period and also to determine the optimal resting time for generating explosive strength after the PAP protocol.

Methods: Ten fitness athletes were recruited for this study. The mean age of the participants group of the research was 26.60±1.07, their height was 178.50±3.02, their weight was 80.00±4.49, their maximal squat repetition performance (1-RM) was 130±7.45, their vertical jump performance was 53.80±1.98 and their explosive strength performance was 14.50±.47. In this research, measurements were completed on five seperate days with 72 hours intervals. On the first measurement day, the athletes' height and weight measurements, 1-RM squat measurements, vertical jump performance measurements were taken and explosive strength levels were calculated using the Lewis formula. On the second measurement day, 5 repetitions were performed with 85% of the 1-RM squat and after 15 seconds of rest, the vertical jump performance test was measured. On the third measurement day, 5 repetitions of 1-RM squats with 85% were performed and after 3 minutes of rest, the vertical jump performance test was measured. On the fourth measurement day, 5 repetitions of 1-RM squat with 85% were performed and after a rest period of 6 minutes, the vertical jump performance test was measured. Finally, on the fifth measurement day, 5 repetitions of 1-RM squats with 85% were performed and after 9 minutes of rest, the vertical jump performance test was measured. After all measurements, explosive strength levels were calculated using Lewis formula. Passive rest was performed between the exercise and the measurement.

Results: It was determined that explosive strength performance was negatively affected 15 seconds after the loading applied within the scope of the PAP protocol, and the difference between the pre-test and the post-test was statistically significant. Bat it was determined that there was no statistical difference between the pre-test and post-test in explosive strength performance 3 minutes after the loads applied within the scope of the PAP protocol. But also it was observed that the explosive strength performance was positively affected 6 minutes after the loading applied within the scope of the PAP protocol, and the difference between the pre-test and the post-test was statistically significant. Finally, it was determined that there was no statistical difference between the pre-test and post-test in explosive strength performance 9 minutes after the loading applied within the scope of the PAP protocol.

Conclusion: As a result of this research, it has been determined that the optimal resting time for explosive strength generation is 6 minutes after the loading applied within the scope of the PAP protocol. In addition, it was determined that explosive strength performance was negatively affected after a short rest period of 15 seconds after the loading applied within the scope of the PAP protocol. In this context, it can be said that optimum performance can occur when fatigue is greatly reduced but the PAP effect is still present.

Keywords: Postactivation Potantiation, Explosive Strength Performance, Complex Training

INTRODUCTION

When the studies aimed at increasing the sportive performance are examined, it is seen that new methods are included in the literature every day[1-3]. Post activation potential (PAP), which is one of the most researched topics of the last period, is thought to be the subject of research for a long time. Because the effects of PAP on muscle physiology and performance can be affected by many different variables such as training method and exercise types. The relationship between exercise intensity and resting time is still a matter of debate in order to take optimum advantage of the effects of PAP.

PAP is the theory that an anterior muscle contraction will acutely increase the intensity of a second contraction[4-6].

There are three theories in the literature that support this theory and try to explain it physiologically. In the first theory; It has been stated that an amplified stimulus will cause a decrease in the pennate angle of the muscle, and as a result, it can cause an increase in power and strength by allowing the power to be transferred from the muscle fiber to the tendon more directly[5,7]. In the second theory; It has been stated that preloaded preparatory exercises may be responsible for increasing the permeability of excitation potentials at the synaptic junction and spinal cord levels[7]. In the third theory; It has been stated that the previous stimulation will phosphorylate the myosin regulatory light chain, move them from the thick body of myosin and move them closer to the thin filaments of actin, and at the same time increase the sensitivity to the Ca^{+2} ion, which facilitates interactions within the sarcomere[5,7,8].

PAP, which is defined as an increase in muscle power performance and force generation speed after exercises performed at maximal or near-maximal intensities[9], is customized with increased muscle strength and power output for 4-20 minutes after voluntary contractions performed at high intensities[10]. It has been stated in many studies that PAP protocols can play a key role in increasing power performance[11-15]. Some previous studies have determined that there is a relationship between maximum strength and PAP, and that strong individuals can benefit from PAP earlier than weak individuals[16-19]. However, while trying to benefit from PAP, other variables such as the type of loading and rest period should be considered [20,21].

Aim of the study: The aim of this research is to examine the effects of PAP on explosive strength performance in terms of the rest period and also to determine the optimal resting time for generating explosive strength after the PAP protocol.

MATERIAL AND METHODS

Participants: This research was carried out with the participation of 10 athletes between the ages of 22-26 who have been fitness athletes for at least five years.

Data collection: In this study, measurements were completed on five separate days with 72 hour intervals. The heights of the participants were measured with a wall-mounted stadiometer (Holtain Ltd. England), and their body weights were measured with an electronic scale (Seca, Germany). Maximal squat repetition performance (1-RM) test[22] was applied to determine the maximal strength performance. In order to determine the explosive strength performance of the athletes, the vertical jump test protocol[23] was applied and the explosive strength levels were calculated using the Lewis formula[24,25].

Pap protocol and measurements: On the first measurement day, the athletes' height and weight measurements, 1-RM squat measurements, vertical jump performance measurements were taken and explosive strength levels were calculated using the Lewis formula. On the second measurement day, 5 repetitions were performed with 85% of the 1-RM squat[26] and after 15 seconds of rest, the vertical jump performance test was measured. On the third measurement day, 5 repetitions of 1-RM squats with 85% were performed and after 3 minutes of rest, the vertical jump performance test was measured**.** On the fourth measurement day, 5 repetitions of 1-RM squat with 85% were performed and after a rest period of 6 minutes, the vertical jump performance test was measured. Finally, on the fifth measurement day, 5 repetitions of 1-RM squats with 85% were performed and after 9 minutes of rest, the vertical jump performance test was measured. After all measurements, explosive strength levels were calculated using Lewis formula. Passive rest was performed between the exercise and the measurement.

Statistical Analysis: Data were analyzed using the IBM Statistics (SPSS version 25.0, Armonk, NY) package program. The normality distributions of the data were tested with the Shaphiro Wilk Test and the kurtosis skewness values were examined. As a result, it was observed that the data were normally distributed. Therefore, the Paired-Samples T-Test was used in the analysis of the data.

RESULTS

The findings of the experimental and control groups are given in tables below.

Table 1: Participant's Age, Height, Body Weight, Maximal Strength, Vertical Jump And Explosive Strength Variables.

Variables	Minimum	Maximum	Mean	Std. Deviation
Age	25,00	28,00	26,6000	1,07497
Height	174,00	183,00	178,5000	3,02765
Weight	74,00	87,00	80,0000	4,49691
Maximal Strength	120,00	140,00	130,0000	7,45356
Vertical Jump	50,00	57,00	53,8000	1,98886
Explosive Strength	13,95	15,17	14,5080	,47076

In Table 1, the mean age of the participants group of the research was 26.60±1.07, their height was 178.50±3.02, their weight was 80.00±4.49, their maximal squat repetition performance (1-RM) was 130±7.45, their vertical jump performance was 53.80±1.98 and their explosive strength performance was 14.50±.47.

Table 2: Effects of PAP on Explosive Strength Performance in Terms of Time

Recovery Time	Pre-test and Post-test	N	X̄±SD	t	p
15 s	Pre-test	10	14,50±,47	8,757	0,000*
	Post-test	10	13,25±,76		
3 min	Pre-test	10	14,50±,47	-,035	,973
	Post-test	10	14,51±,46		
6 min	Pre-test	10	14,50±,47	-6,230	,000*
	Post-test	10	14,83±,49		
9 min	Pre-test	10	14,50±,47	-,557	,597
	Post-test	10	14,52±,45		

*p<0,05

In Table 2, it was determined that explosive strength performance was negatively affected 15 seconds after the loading applied within the scope of the PAP protocol, and the difference between the pre-test and the post-test was statistically significant. Bat it was determined that there was no statistical difference between the pre-test and post-test in explosive strength performance 3 minutes after the loads applied within the scope of the PAP protocol. But also it was observed that the explosive strength performance was positively affected 6 minutes after the loading applied within the scope of the PAP protocol, and the difference between the pre-test and the post-test was statistically significant. Finally, it was determined that there was no statistical difference between the pre-test and post-test in explosive strength performance 9 minutes after the loading applied within the scope of the PAP protocol.

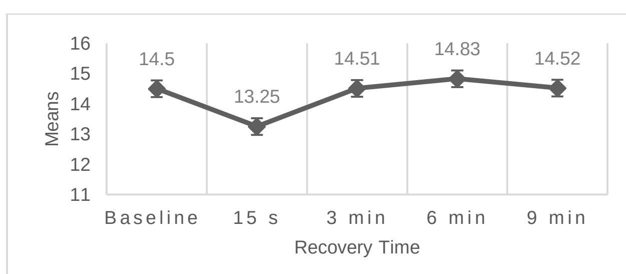

Figure 1: Explosive Strength Performance Averages in Terms of Recovery Time

According to Figure 1, it can be said that the most optimal resting time for PAP effects is 6 minutes.

DISCUSSION

One of the most important factors that determine the effect of PAP on performance and make the researchers' studies different from each other is the rest interval between PAP exercise and performance test.

In some studies, it has been reported that high-intensity warming with preload causes muscle fatigue and therefore jumping performance is negatively affected[13,27-29]. Accordingly, it can be said that optimal performance can be produced when muscle fatigue is reduced.

It is known that fatigue occurs after the load applied within the scope of the PAP protocol. It is a misconception that the effect of PAP and fatigue are together, and that the effect of PAP will decrease when fatigue decreases. Optimal performance occurs when fatigue is reduced but the PAP effect is still present[13,30]. Finding the optimal rest interval is important in order to benefit from the PAP effect at the highest level.

In studies examining the effects of PAP in terms of recovery time, it has been stated that a rest period of up to 20 minutes may have a positive effect on power performance[31]. But the rest interval, which is commonly used in the literature to achieve an optimal PAP effect, ranges from 3 to 8 minutes[7,32,33].

In this research, it was determined that explosive strength performance was negatively affected 15 seconds after the loading applied within the scope of the PAP protocol, and the difference between the pre-test and the post-test was statistically significant. But it was determined that there was no statistical difference between the pre-test and post-test in explosive strength performance 3 minutes after the loads applied within the scope of the PAP protocol. But also it was observed that the explosive strength performance was positively affected 6 minutes after the loading applied within the scope of the PAP protocol, and the difference between the pre-test and the post-test was statistically significant. Finally, it was determined that there was no statistical difference between the pre-test and post-test in explosive strength performance 9 minutes after the loading applied within the scope of the PAP protocol.

When the existing studies in the literature are examined, it is seen that there are studies that show parallelism with the results of our research, as well as studies that do not match the results.

In a study, it was reported that the rest interval of 5-7 minutes after PAP exercise reached maximum performance for athletes with high aerobic power performance, while this interval started after 8 minutes for athletes with lower aerobic power performance[34,38,39]. In another study, it was reported that the highest power level after a plyometric PAP exercise occurred after a 5-minute rest interval[35]. These findings are explained by the fact that athletes with higher training levels have a higher resistance level against fatigue and therefore the PAP effect is earlier[6.35]. In connection with this explanation, in a study consisting of professional athletes with a participant group, it was reported that there was an increase in the vertical jump performance of the athletes after a 3-minute rest period after exercise within the scope of the PAP protocol[26]. However, there are some studies showing that the rest intervals after PAP application do not have any effect on the sportive performance of the athletes. In a study conducted with the participation of rugby athletes, it was reported that the rest intervals after PAP application did not have any effect on the sportive performance of the athletes[33]. In addition, in some studies where the vertical jump performance levels of different sports athletes were measured after PAP application, there was no significant difference in jump performance according to the measurement results[9,36,37,40]. Based on all these data, it can be said that PAP can be affected by the performance level of the athlete, the type of branch performed, the PAP protocol applied, and the rest period.

CONCLUSION

As a result of this research, it has been determined that the optimal resting time for explosive strength generation is 6 minutes after the loading applied within the scope of the PAP protocol. In addition, it was determined that explosive strength performance was negatively affected after a short rest period of 15 seconds after the loading applied within the scope of the PAP protocol. In this context, it can be said that optimum performance can occur when fatigue is greatly reduced but the PAP effect is still present.

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