

Post Activation Potentiation for Lower Limb with Eccentric and Concentric Movements on Sprinters

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Abstract Muscle contractions preceding to high intensity activity can result in increased force and power generation (postactivation potentiation[PAP]). Although the type of muscular contractions could affect subsequent strength and power performance, little information exists on their effects. According to some authors augmentation is one of the most frequently used methods to acquire the strength and rapid reaction capacity of the muscle immediately. In this work was evaluated the effects of post-activation potentiation (PAP) for lower limb movements with eccentric and concentric *sprinters*. The study included 10 males with 15.8 ± 0.8 years, 67 ± 7.41 kg bw and 1.75 ± 0.07 m in height. The test had 05 sessions with a minimum interval of 72 hours between each session, with the first 3 familiarization sessions and testing of 1RM concentric and eccentric, then the collections have more tests in two sessions with one another in the concentric phase and the eccentric with 50m shot. The results presented here underscore the importance of training loads in concentric actions, because the speeds achieved are higher than those of the eccentric actions, showing significant gains in strength after the PPA of the concentric squat.

Keywords Potential Post-activation, Velocity

1. Introduction

Speed training requires more attention by coaches, despite of this physical capacity being responsible by the athlete's quality and competence. Speed demand several combinations between neuromuscular system and motivation to achieve a distance in a lower time, therefore requiring a higher frequency of impulse and movements.

The load imposed to neuromuscular system, near or even above of the muscle group maximum load, provides a state which explosive action performance can be enhanced[1]. This training methodology is named Post Activation Potentiation (PPA). The PPA is a consolidated strategy, which promotes acute responses to the imposed load in explosive efforts. The muscle mechanisms responsible by PPA seem to involve the myosin light chain, even the enhancing of α -motoneuron excitability[2]. This situation would give to troponin molecules more sensitivity to calcium ions, favoring the actine molecules active sites exposition, and by consequence, a faster cross bridge formation ([3],[4]).The PPA conception assumes that muscle Power

may have their expression enhanced if proceeded of an activation, realized across counter resistance intense actions ([5-9],[1])

Studies identified upper limb Power developments[10] and lower limbs developments[11], even 15m sprints[12]. In relationship to sequence muscle actions, as 50m running, there are not researches yet. Thus, the present study aims to evaluate the efficiency of eccentric and concentric movement stimuli on 50m running young athletes.

2. Materials and Methods

Ten speed athletes were recruited for the study, which competes in 100m and 200m, with means of $15,8 \pm 0,8$ years old, $67,0 \pm 7,4$ mean weight, $1,75 \pm 0,10$ m higher, and lean practical experience of 3 years, acting in state level competitions. The training was systematic on 4 times per week frequency. The training program includes strength and sprint training. The participants were informed before the data collect starts of the objectives of the study. As the whole athletes are young, the parents were informed of the study, received a written informed consent and just the athletes that had the term signed kept on the study.

2.1. Methods

The data was collected in atletism official track,

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consisted by 5 training sessions, with at least 72 recovery between the collect, realized at 4 pm.

All the sessions was consisted by a warm up, consisted by 3 completed running on track, coordination techniques, followed by lower limb stretching. On the first day, the athletes had maximum load familiarization on squat, high and weight measurement, followed by concentric and eccentric maximum strength tests, with 72 h between each one. The athletes already had higher strength squat experience.

The maximum load test was applied as reference[13] protocol, with half squat, with 90° regulation. This protocol was done in two phases: 9 km/h warm up, for 10 minutes, followed by 50 to 70% maximum strength 5 repetitions. The test initiates by a 50m running[14], followed by 60 minutes rest, composed by technique movement, just to keep achieved. In the second phase, each athlete realized 3 squats with 90% of concentric maximum strength (PPA CON), and 4 minutes after the squat, started another 50m running. The last day was composed by the same protocol, by with 90% eccentric maximum strength (PPA ECC). The figure 1 presents the PPA protocol scheme.

2.2. Statistics

Was applied the Komolgorov-Smirnov normality test, with reference value of $P > 0,01$, and to compare the difference between means, was applied the T Test, with significant reference value of $P < 0,05$.

3. Results

In relation to PPA COM, was observed significant difference ($P < 0,001$) of 50m displacement time, with post to

pre decrease (2% mean). The table I presents the tests realized:

4. Discussion

The PPA phenomenon is recent knowledge in sports science, and then, their effects analyze over muscle power activities on several actions still controversial. So, the present study aim to evaluate the effect of two protocols of distinct muscle actions under young speed 50m displacement,

The results obtained on the present study showed that the Power produced after the 3 repetitions, with 90% of maximum concentric strength intensity, provides acute enhancing on athlete's after the PPA CON protocol, being in line to other studies ([15],[16]), in spite of the PPA ECC, where did not showed improvement.

The results of the present study do not support with the results of references ([17],[18]), which did not observed differences in eccentric, concentric and isometric actions.

Analyze the time mean variations on PPA CON (2% performance enhancing), with PPA ECC (1,5% performance decrease) we may affirm that concentric muscle actions allowed performance enhancing on young athletes, in disadvantage to eccentric muscle actions, in acute effects. Study of[12], analyzing the lower limb maximum contractions effects on lower limb power and 15m sprint displacement time, observed negative correlation between 15m sprint time and muscle contraction time post PPA ($r = -0,59$, $P < 0,05$), indicates that PPA provides beneficial effects to sprint performance enhancement, as observed on the present study.

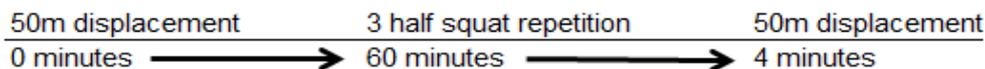


Figure 1. PPA protocol scheme

Table 1. results of tests of maximum strength concentric, eccentric, 50m displacement time on PPA COM and PPA ECC. Individual and mean±standard deviation results. ¥ $P < 0,001$ comparing to Pre

Subject	CON Max	ECC Max	Variation (%)	PPA CON		PPA ECC	
	Strenght	Strenght		Pre (s)	Post(s)	Pre (s)	Post(s)
1	136	182	34	7,16	7,01	6,92	7,17
2	102	162	59	6,34	6,19	6,36	6,44
3	142	192	35	6,28	6,17	6,27	6,32
4	132	182	38	6,96	6,84	6,80	6,98
5	122	172	41	6,25	6,08	6,44	6,40
6	92	162	76	7,54	7,48	7,33	7,66
7	82	152	85	6,68	6,55	6,70	6,65
8	112	182	63	7,13	6,97	6,99	6,86
9	102	152	49	6,47	6,25	6,35	6,55
10	92	162	76	6,48	6,50	6,38	6,51
Mean ±	110,4	170,9	57,2	6,73	6,60¥	6,65	6,75
Standard Deviation	±21,5	±14,0	±19,0	±0,44	±0,46	±0,35	±0,42

After the maximum strength obtain, is possible to analyze even the displacement time on PPA CON e PPA ECC, with 90 minutes rest time between pre and post activation. Despite of PPA CON enhancement, the eccentric maximum strength results were better than concentric ones. Reference[11] reports that the training applied on eccentric actions, but with 80% of the eccentric maximum strength enhances the muscle resistance, maintaining the performance for more days after stimuli.

Lastly, the results presented on this study emphasize the importance of high load concentric actions, even the results obtained are higher than eccentric actions, exhibiting significant enhances ($P < 0,05$) on explosive actions

Our results allows recommend to speed coaches the PPA CON use, adapting volume and intensity by the athlete's conditioning level, and with a 4 minutes recovery time, enhancing the performance in power and speed activities specifically, the PPA mechanism must be used by coaches in strength and power training sessions, moments that there are requiring maximal motor units recruitment, even before explosive competition events, as jumps and sprints.

5. Conclusions

The results pointed that 90% concentric strength squat on PPA CON, causes acute improvement on 50m displacement speed performance, despite of eccentric muscle actions, that provides significant decreases on this group performance.

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