EFFECT OF PAP INTERVENTION DURING WARM-UP ON THE PERFORMANCE OF COUNTERMOVEMENT JUMP OF VOLLEYBALL PLAYER

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Abstract

Modern volleyball is now considered to be a power game. The player who was able to perform the movement explosively got better chance to get success over the opponent. The Volleyball player has to perform the squat jump, countermovement jump and drop jump in the varied situation during the game. A total of 15 inter university players agreed to participate in the study and were present during the familiarization and anthropometric measurements. (Mean±SD; age 21±1.2 years; height 1.7±8.2m; body mass 66.8±7 kg; fat %10.2±2.4 %) One familiarization session was conducted for the participants with the PAP and test protocols to avoid possible interferences in the results as a function of learning and coordination of movements. the subjects first underwent a 10-minute warm-up, followed by baseline assessments, PAP intervention and countermovement jump. Subjects performed 5 sets of Counter Movement jump with a rest period of 10 seconds between repetitions and 60 seconds between sets with the help of G-Sensor. Statistical analysis of the acquired data was performed using IBM SPSS (version 20.0.0). Shapiro–Wilk test was conducted to check the violations of the assumptions of normality. Non-parametric tests equivalent to its parametric counterpart were used for the analysis of non-normal data. Post-hoc paired t-test with a bonoferroni adjustment p= 0.01 was used to see the effect of PAP. It was clearly indicated that parameters of counter movement jump namely , jump height(t_{14}= -3.340, p = .005), take off force (t_{14}= –3.350, p=.005), impact force (t_{14}= -2.529, p=.024), maximum concentric force (t_{14}= –2.502, p=.005) and take off speed (t_{14}= – 3.17, p= .002) showed significant effect of post activation potentiation at 0.05 level of significance. The post activation potentiation helps to recruit more number of muscle fiber and make more number of cross bridges during action which enhances the performance of countermovement jump.

Keywords: Post Activation Potentiation, countermovement jump, G-Sensor

Introduction

The Vertical jump is considered to be the prime factor in achieving success in volleyball (Zoran Grgantov, Mirjana Miliæ, 2013). The height of action above the net is the deciding factor for victory or defeat in modern top volleyball(Horst, Baacke, 2019; Riggs & Sheppard, 2009). The Volleyball player has to perform the squat jump, countermovement jump and drop jump in the varied situation during the game (Reeser C. Jonathan, 2003). The frequency of jumps also depends on their specific positions as the setter, attacker, and blocker have varied repeated jumping frequencies(Sheppard et al., 2009). For achieving the greater reach at the moment of ball contact during a spike, block and in jump serve the player should increase the recruitment velocity of motor units and also the good coordination among motor units to increase the explosiveness(Nemec et al., 2016). The study indicated that greater ability of counter movement jump has better agility times which helps the volleyball player to change the direction in a quicker way (Barnes et al., 2007).

Dynamic warm-up plays a great role in the performance of vertical jump, as it increases the muscular blood flow and body temperature which mobilize the joints. Various studies conducted on various protocols of warm up to see the effect on Countermovement jump. (Fattahi et al., 2015; Gelen, 2011).

Post activation potentiation is a physiological

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process, which used to perform before the main activity to increase the stimulation of motor units by increasing the firing rate of the motor unit, calcium concentration and also to increase the cross-link between actin and myosin filament. (Costa et al., 2017).

There were various studies on post-activation potentiation (PAP) for various main activities and almost all the main activities results were positively significant after PAP Activities(Costa et al., 2017). The spike in volleyball is an excellent example of a countermovement jump (CMJ) (Reeser C. Jonathan, 2003), which is the combination of the stretch-shortening cycle (Cheraghi et al., 2017). In the CMJ the quadriceps get eccentrically pre-loaded before concentric contraction, preactivation of the tibialis anterior required for a powerful and efficient transition from eccentric to the concentric phase(Reeser C. Jonathan, 2003). In drop jump, an excessive amount of eccentric contraction takes place as there is more strain than normal vertical jump which give a positive impact on the kinetic parameter. The effectiveness of the explosiveness depends upon the amortization phase(Davies et al., 2015). Drop jump training has a positive impact on countermovement jump, squat jump and drop jump performance (Aboodarda Saied Jalal, Phillip A. Page, 2015; Gehri et al., 1998). None of the studies were conducted on the weighted drop jump as post-activation potentiation protocol in the warm-up (As per the Author's knowledge). As the weighted drop jump puts more strain in eccentric contraction and may enhance the performance of a vertical jump (Makaruk & Sacewicz, 2011).

Experimental Approach to the Problem

A design with a controlled condition was used to investigate the effect of PAP protocol after a warm-up on MAT and countermovement performance. The participants were evaluated on 2 separate days with a minimum interval of 48 hours between sessions to avoid carry-over effect.

After 3 minutes of baseline assessments, subjects have to follow PAP protocol. The post-intervention assessment was done at approximately 3 minutes, as the PAP effect in ballistic exercise has been observed with recovery duration ranging from 1 to 3 minutes.

Subjects

A total of 15 subjects agreed to participate in the study and were present during the familiarization and anthropometric measurements. (Mean±SD; age 21±1.2 years; height 1.7±8.2m; body mass 66.8±7 kg; fat %10.2±2.4 %) . The study was conducted during the off-season after completion of the university games. Inclusion criteria for the study werethe absence of major lower limb injury in the past 6 months, any other recent injury, or neuromuscular disorder which could potentially limit performing sprints and jumps. Subjects reported participation in plyometric training in the past. After the explanation of the procedures, players signed the informed consent form, confirming their voluntary participation in the study.

Procedure

One familiarization session was conducted for the participants with the PAP and test protocols to avoid possible interferences in the results as a function of learning and coordination of movements. Player's fitness characterization by anthropometric measures was obtained the same day. Height, body mass, and body fat percentage (20) were recorded (Table 1). The mean daily temperature during data collection was 28ÚC (82.4Ú F). The participants were asked to avoid alcohol for 24 hours, caffeine for 6 hours, food for 3 hours before the assessment and any strenuous exercise 24 hours prior, or between the assessment days.

On the assessment day, the subjects first underwent a 10-minute warm-up, followed by baseline assessments, PAP intervention and countermovement jump. Warm-up started with dynamic stretching exercises in a full kinematic range for hamstrings, quadriceps, adductors, hip flexors and soleus. Baseline assessment for pre data and it was followed by PAP intervention which includes jogging and 5 drop jump (65 cm height) and 3 repeated sprints performed thrice by the participants.

CMJ Protocol

Subjects performed 5 sets of Counter Movement jump with a rest period of 10 seconds between repetitions and 60 seconds between sets with the help of G-Sensor. BTS G-Sensor (S.P.A., Italy) which has tri-axial accelerometer with multiple sensitivity (±1.5 g, ±6 g), tri-axial magnetometer and tri-axial gyroscope with multiple sensitivity (±300 gps, ±1200 gps) was used to measure the outcomes of the drop jump. The protocol was set to drop jump in G Studio's (ver. 3.3.22.0) jump protocol section. Jump height, take-off force, impact force, maximum concentric power, peak speed, and take-off speed were the outcome variables of drop jump using the G-sensor and G-studio software.

Fig-1. Subject Performing Counter movement Jump

Statistical analysis

Statistical analysis of the acquired data was performed using IBM SPSS (version 20.0.0). Shapiro–Wilk test was conducted to check the violations of the assumptions of normality. Non-parametric tests equivalent to its parametric counterpart were used for the analysis of non-normal data. Post-hoc paired t-test with a bonoferroni adjustment p= 0.01 was used to see the effect of PAP.

Effect of PAP test on Parameters of Countermovement Jump using G- Sensor
Table-1

S.No	*Pair*	*Variable*	*Mean*	*Std. Dev*	*df*	*t*	*p value*
1.	Pair 1	Jump Height Pre	38.1933	1.47526	14	-3.340	.005
		Jump Height Post	39.4933	1.91888			
2.	Pair 2	Take off Force Pre	.6613	.02264	14	-3.350	.005
		Take off Force Post	.6900	.02138			
3.	Pair 3	Impact Force Pre	.8867	.02769	14	-2.529	.024
		Impact Force Post	.9047	.01922			
4.	Pair 4	Max. Concentric Power Pre	3.1140	.05527	14	-2.502	.025
		Max. Concentric Power Post	3.1567	.05512			
5.	Pair 5	Take off Speed Pre	2.6807	.02492	14	-3.917	.002
		Take off Speed Post	2.7073	.01944			

Results

Table-1 shows the value of all measured variables. The outcome of the PAP on parameters of countermovement paired – t test was significant. It was clearly indicated that parameters of counter movement jump namely, jump height ($t_{14} = -3.340, p = .005$), take off force ($t_{14} = -3.350, p = .005$), impact force ($t_{14} = -2.529, p = .024$), maximum concentric force ($t_{14} = -2.502, p = .005$) and take off speed ($t_{14} = -3.17, p = .002$) showed significant effect of post activation potentiation at 0.05 level of significance. The post activation potentiation helps to recruit more number of muscle fiber and make more number of cross bridges during action which enhances the

performance of countermovement jump. Hence it is advisable to perform appropriate technique of post activation potentiation before the competition to get maximum advantage.

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