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Effect of fatigue on body joints kinematic in 3 point jump shot among basketball player young boys

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ABSTRACT: The aim of this study was Effect of fatigue on body joints kinematic in 3 point jump shot among basketball player young boys. First, selected10 basketball player young boy from karaj city club with 19±2, 16 years old, 73, 9±14, 54 weight and 185±6, 78 height. All of them were player in area 1, 2 and 3 that they have a good technique and high performance in jump shot and were right handed. They do 15 jump shot at rest (pre- test) and then subjects participates in fatigue protocol and for second time did the 15 3 points jump shot(post- test)for pre and post- test kinematic parameters of joints angle by photography were analyzed in two extroverted and introverted phase. Statistical analyze of data via correlation t test (?= 0/05) showed fatigue can due to increase in minimum flexion of knee in both of extroverted and introverted phase. Also in introverted phase range of motion were reduced but there is no kinematic parameters changes in hip, trunk and shoulder. The results indicate minimum flexion of elbow in introverted phase was reduced. Finally, it was found that fatigue may be affected on jump shot by Motor cortex excitability on minimum flexion in extroverted and introverted phase of knee and introverted phase of elbow and reduction of knee range of motion.

Keywords: fatigue, joints kinematic, jump shot

INTRODUCTION

The main objective of each basketball player during a game is to score points. In an attempt to do so, an athlete might perform a jump shot, set shot, layup or a free throw. As the discipline has evolved and more athletic players have practiced this sport discipline, defense has become increasingly efficient. As a result, the two legged jump shot has become more frequent, amounting to over 70% of all the shots during a game, which necessitates a greater performance level for athletes executing the jump shot to increase the height at which the ball is released (i.e., the release point). This movement must be automated so that, regardless of the external factors, the player achieves maximum repeatability. The factors that affect the height at which a shot is performed include the shooter body height, jump height and arrangement of body parts. Since first used in the 1940's, the jump shot has become the most potent and utilized means of scoring in the game of basketball. In today's game, effective jump shooters should be able to shoot accurately from long range, especially when fatigued (Oudejans *et al.,* 2012, Kornecki *et al.,* 2002).

Miller and Bartlett 1996, Clearly, 2001). Basketball is an intermittent sport that involves both intensive short movements (e.g., jumping, sliding, sprinting) and less intensive longer movements (e.g., walking, running). Altogether, the physiological demands of basketball game on players, which requires both aerobic and an-aerobic energy delivery systems, were claimed to be high. Moreover, not only the blood lactate levels but also the mean heart rates of the players during a competitive game were found to be close to their maximal values (Bompa, 1994, Ben Abdelkerim *et al.,* 2007, McInnes *et al.*, 1995).

As a result, fatigue becomes an indispensible part of the game that may deteriorate the performance, the coordination and the skill of a player (Forestier and Nougier 1998, Ivoilov *et al.,* 1981, Kellis *et al.,* 2006, Lyons *et al.*, 2006).

Fatigue can be instigated by various mechanisms, ranging from accumulation of metabolites within muscle fibers to generation of an inadequate motor command in the motor cortex (Enoka and Duchateau 2008). The effect of fatigue on other domains as physical or cognitive performance was not fully understood and it is still under investigation. Some of the causes of fatigue are shown in Fig. 1.

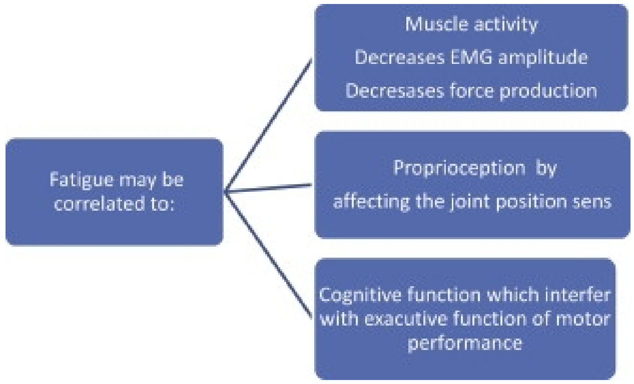

Fig. 1. Some of the causes of fatigue.

Fatigue is a factor that has been linked to stress, safety, and performance decrements in numerous work environments. As such, the role of fatigue in medical errors and healthcare worker safety should be further clarified. Previous investigations of the relationship between fatigue and performance in healthcare have focused on specific components of fatigue; for example, sleep deprivation in medical trainees, or physical fatigue in laparoscopic surgeons. However, a more comprehensive definition of fatigue encompassing multiple dimensions (e.g., mental fatigue and physical fatigue) has not been considered in existing research. Fatigue is a complex construct, and which has not yet been clearly defined independent of Context. "Fatigue" is a term used to describe a decrease in physical performance associated with an increase in the real/perceived difficulty of a task or exercise. From another aspect, fatigue is defined as the inability of the muscles to maintain the required level of strength during exercises. Alternatively, it can be defined as an exercise induced reduction in muscle's capability to generate force. The term muscle fatigue was used to denote a transient decreases in the muscle capacity to perform physical activity. Performing a motor task for long periods induces motor fatigue, which is generally accepted as a decline in a person's ability to exert force. Fatigue is reflected in the EMG signal as an increase of its amplitude and a decrease of its spectral characteristic frequencies (Ahsberg *et al.,* 2000, Akerstedt *et al.,* 2004, MacInstosh *et al.,* 2005, Edwards,1981, Friedman *et al.* 2007, Lorist *et al.,* 2002, Kallenberg *et al.,* 2007).

MATERIAL AND METHODS

In this research tried to evaluation of Effect of fatigue on body joints kinematic in 3 point jump shot in basketball player young boys. For this study selected 10 basketball player young boy from karaj city club with 19±2, 16 years old, 73, 9±14, 54 weight and 185±6, 78 height. All of them were player in area 1, 2 and 3 that they have a good technique and high performance in jump shot and were right handed. Before main protocol, Fatigue method and Photography, Lighting, marker making and information recording was tested on a student. First of all, subjects warmed up and then markers putted on ankle, Knee, hip, trunk, shoulder, elbow, and wrist joints for pre test. All of subjects did the 15 time 3points jump shot from 6/75 cm at rest and then recorded with 2 cameras on sagittal plane with 120 frames per seconds. In the next phase subjects in 8 stations did the fatigue protocol and in the end of the test evaluated fatigue with sing Borg's ratings of perceived exertion scale and they did 15 time 3points jump shot immediately. Total of information analyzed with Excel, Matlab and Kinova software. The data filtered in two axes X and Y and then organ absolute angle and relative joints angle were obtained and angular speed and acceleration among joints were obtained too. Finally, with knee joint graph, determinate the extroverted and introverted phase and in every phase maximum and minimum of joints angle and range of motion were obtained, also minimum and maximum of angular speed in joint extroverted and introverted phase were determinate. Statistical information were analyzed in α = 0/05 significant level.

RESULTS

Our results indicate that minimum flexion of knee in extroverted phase significantly increases in post-test. Maximum flexion of knee in extroverted phase increase in post-test but it is not significant. The range of motion and maximum speed in flexion reduced but no significant different between pre and post test. The summary of results for comparison of knee joint kinematic parameters in jump shot extroverted phase showed in Table 1.

Table 1: Correlated groups t test for comparison of knee joint kinematic parameters in jump shot extroverted phase.

	Mean & standard deviation		Results for Correlated groups t test
Angular Kinematic parameters of knee	Pre-test	Post-test	
Minimum flexion (degree)	39.76±14.52	35.75±15.06	t 9 = 3.037, Sig = 0.014*
Maximum flexion(degree)	70.38±11.28	69.66±9.61	t 9 = -o.445, Sig = 0.667
Range of motion(degree)	30.62±17.23	33.91±15.44	t 9 = 1.794, Sig = 0.106
Maximum speed in flexion (degree/sec.)	196.43±61.64	214.47±39.81	t 9 = 1.086,Sig = 0.360

*Significant different between pre- test and post-test

Our results also indicate that minimum flexion of knee in introverted phase significantly increases in post-test. Maximum flexion of knee in introverted phase increase in post-test but it is not significant. The range of motion of knee reduced significantly between pre and post test. The Maximum speed in return from flexion (extension speed) in introverted phase reduced but no significant. The summary of results for comparison of knee joint kinematic parameters in jump shot introverted phase showed in Table 2.

Table 2: Correlated groups t test for comparison of knee joint kinematic parameters in jump shot introverted phase.

	Mean & standard deviation		Results for Correlated groups t test
Angular Kinematic parameters of knee	**Pre-test**	**Post-test**	
Minimum flexion (degree)	8.90±7.36	5.13±4044	t 9 = 2.563, Sig = 0.031*
Maximum flexion(degree)	70.29±11.22	69.53±9.61	t 9 = 0.470, Sig = 0.650
Range of motion(degree)	61.39±9.88	64.40±10.12	t 9 = 2.521, Sig = 0.033*
Maximum speed in return from flexion (degree/sec.)	428.56±97.95	442.15±109.63	t 9 = 0.554, Sig = 0.593

*Significant different between pre- test and post-test

The results indicate that Fatigue does not affect on Angular Kinematic parameters of elbow in extroverted phase and minimum flexion, maximum flexion and maximum speed in flexion in post- test increased but range of motion were reduced. The summary of results for comparison of elbow joint kinematic parameters in jump shot extroverted phase showed in Table 3.

Table 3: Correlated groups t test for comparison of elbow joint kinematic parameters in jump shot extroverted phase.

	Mean & standard deviation		Results for Correlated groups t test
Angular Kinematic parameters of elbow	**Pre-test**	**Post-test**	
Minimum flexion (degree)	78.24±17.79	68.73±21.49	t 9 = -1.191, Sig = 0.264
Maximum flexion(degree)	114.62±16.42	113.32±16.27	t 9 = 0.423, Sig = 0.682
Range of motion(degree)	36.37±15.16	44.59±27.37	t 9 = 1.375, Sig = 0.202
Maximum speed in flexion (degree/sec.)	338.23±201.61	336.13±198.19	t 9 = 0.137, Sig = 0.894

*Significant different between pre- test and post-test

Finally, our results indicate Minimum flexion of elbow in introverted phase significantly increased in post- test. Also maximum flexion and maximum speed in return from flexion increased but no significant. The range of motion in post- test reduced but no significantly. The summary of results for comparison of elbow joint kinematic parameters in jump shot introverted phase showed in Table 4.

Table 4: Correlated groups t test for comparison of elbow joint kinematic parameters in jump shot introverted phase.

	Mean & standard deviation		**Results for Correlated groups t test**
Angular Kinematic parameters of elbow	Pre-test	Post-test	
Minimum flexion (degree)	29.22±11.29	20.63±14.26	t 9 = -2.406, Sig = 0.039*
Maximum flexion(degree)	124.60±10.40	121.05±12.47	t 9 = -1.733, Sig = 0.117
Range of motion(degree)	95.38±10.20	100.41±16.31	t 9 = 1.225, Sig = 0.0.252
Maximum speed in return from flexion (degree/sec.)	785.91±81.94	626.49±242.73	t 9 = -2.052, Sig = 0.070

*Significant different between pre- test and post-test

DISCUSSION

In this study, angular speed of knee joint reduced and angular speed of elbow joint increased that this due to increasing time of jumping for ball releasing. At the beginning of the extroverted phase more curvature occurs in knee joint and in introverted phase knee joint can not to be extent properly. In extroverted phase fatigue of quadriceps muscle cause to increase in knee joint flexion and extroverted resistance in this muscle weakness and failures. As a result quadriceps muscle can not to be resistance against knee flexion, gravity effect and flexor muscle contraction. The significant reduce in range of motion of knee joint in introverted phase could be because. In study entitled: The kinematic analysis of basketball three point shoot after high intensity program showed that angular speed of elbow joint, wrist, ankle and hip reduced after High impact exercise but increasing in angular speed of knee joint, angular speed of other joint to be compensated (Tsai *et al.,* 2006).

Time to get up to throw the ball reduced that indicates a lack of coordination between elbow and knee joints. Also there is a more curvature in elbow and knee after high impact exercise for jump shot. The fatigue that applied to muscles, especially to quadriceps when 3 points jump shot with knee flexion and eccentric contraction of quadriceps due to negative contraction with less motor unit for contraction. In this condition the muscle faced with less alpha motor neuron in eccentric contraction that tries to keep knee angle and resistance against gravity. So, increasing in minimum flexion of knee is fatigue affects that is due to the internal muscle fatigue and extroverted phase of quadriceps muscles. Even when the muscle is tired, central factors related to the perceived exertion have an important role with respect to environmental changes for strength development. As a result of fatigue biomechanical model, improving in movement leads to less energy. During cycle of eccentric and concentric and reduction process of strength during repeated submaximal cycles of stretch - shortening is result of reduction in reflex components that protection mechanism of Central Nervous System(CNS) has been interpreted. In study entitled: The Effect of Fatigue on the Kinematics of Free Throw Shooting in Basketball (Uygur, 2010) showed that joints angles during Successful and unsuccessful shoot is not affected by fatigue and Fatigue did not affect the elite athletes. A study indicates the effect of upper extremity fatigue on basketball shooting accuracy, and results showed no significant reduce in shooting accuracy (Wan-chin *et al.,* 2005).

Some Changes by activity and fatigue in muscle fiber action potential caused to slow specified conduction velocity with contractions boring. The overall result of this study showed general fatigue just affected on knee and elbow joints may affect the outcome of the shot that it seems part of these negative effect compensated by adjacent joints.

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