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Comparing the Effects of Plyometric Depth Jump and Rim Jump Training on the Explosive Power of Leg Muscle and the Level of Creatine Phosphokinase of Basketball Players

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***Abstract*—this experimental study was aimed at comparing plyometric depth jump and plyometric rim jump training on the explosive power of leg muscle and the level of Creatine Phosphokinase (CPK) of basketball players. 28 male basketball players were involved in this study and were randomly divided into two groups. Measurement on the explosive power of the leg muscles were carried out before and after training and the level of CPK was measured after 24 hours of the first training. And after having the training for 6 weeks, same measurements like the first ones were taken. From the results, it was discovered that the final measurement of group A showed a great increase in the explosive power of leg muscles (54.71 ± 5.40 vs. 60.50 ± 5.35), leg muscle strength (136.21 ± 152.71 ± 12.45 vs. 13.77), and levels of CPK (237.6 ± 146.1 vs. 329.4 ± 182.9). In group B, it was also discovered that there was an increase in the explosive power of leg muscles (54.86 ± 6.62 vs. 58.86 ± 6.33), and but a decrease in the level of CPK (356.3 ± 214.2 vs. 226.4 ± 148.6). This study concludes that, plyometric depth jump training is more effective in increasing the explosive power of leg muscles and the level of CPK compared with plyometric rim jump training.**

Keywords—CPK, Plyometric Depth Jump, Plyometric Rim Jump, and Explosive Power

I. INTRODUCTION

There is no doubt that basketball is one of the most popular sports in the world and it is a game that is changing both in terms of rules and the equipment used. This regulatory change will also change the pattern of high-intensity basketball games causing an anaerobic predominant movement pattern change. Also, the high-intensity basketball games could increase the risk of injury to basketball athletes [7]. Anaerobic predominant movement patterns change in occur during a fast break, power lay-up, jump shot, offensive and defensive rebound.

A basketball athlete who trains regularly so as to achieve an optimal performance will experience a systematic and progressive according to the intensity of the training. For this reason, many basketball athletes do high-intensity workouts in order to perform better. According to some researchers, high-intensity training increases the risk of having injuries, especially the skeletal muscle damage [2, 7, 8] Therefore, the basketball athletes have a higher risk of having injury because of their high-intensity trainings. There are several factors causing these injuries after the training, in the form of macro trauma. And the macro trauma that can occur after the high-intensity training is a strain in the joint or the breaking of the ligament (sprain). Also, muscle damage can also be in the form of micro trauma on muscle cells [4, 24]. In general, macro trauma is followed by a relatively long time micro trauma, thereby causing more severe muscle damage during high-intensity training. It is therefore recommended that to prevent more severe muscles damage, indicators that are able to indicate. Then, it is recommended to prevent more severe muscle damage using indicate micro trauma on muscle cells sarcolemma, among these is by measuring CPK enzyme levels [8, 22, 30]

Various indicators to show muscle cell damage after high-intensity physical activity are characterized by increased levels of CPK, LDH (Lactate Dehydrogenase) and myoglobin serum [3, 6] this indicator possibility can be used to predict micro trauma damage after doing plyometric depth jump training. High intensity training destroys sarcolemma due to the continuous movement during physical activity and this causes the removal of CPK enzymes from muscle cells into the circulatory system, thereby increasing the levels of CPK enzymes in circulation. This can serve as an indicator of micro trauma in muscle cells [5, 9]. A lot of studies reported that there was a significant increase of CPK enzymes in the circulatory system 24 and 48 hours after sprint training [11]. There was an increase in CPK level by 420% 24 hours after performing a VO2 max test with a run test. However, there has been no report of how much damage that occurs on muscle cells after doing plyometric depth jump training [10]. The predominant physical components needed by the basketball athlete to achieve peak performance during training or basketball games are the explosive power of the leg muscle and arm muscles, leg muscle and arm muscle strength, and its flexibility [5, 15]. Among the predominant physical components needed to achieve the peak performance required of a basketball athlete, the most important one is the explosive power of the leg muscles [15]. For this reason, various efforts are made to increase this explosive power of the leg muscles. Plyometric depth jump training method is one of the most popular methods recently used and it has a higher risk of causing injury due to its movement pattern. Plyometric depth jump training is one of the many forms of Plyometric training by using an additional equipment which is the Plyometric Box. It starts with a basketball athlete standing on a plyometric box, then jumps down to the floor with both legs followed by maximum vertical repulsion and performed with explosive and high-intensity movements [34] and the risk of injury in this training method is relatively high. And the movement pattern plyometric depth jump training performed with high intensity are known as anaerobic predominant physical activity [21]. It is highly possible that this physical activity damages the muscles which then causes injury to athletes. To avoid more severe muscle damage, some parameters are needed to determine whether any mild muscle damage occurs, among which is by measuring the levels of the Creatine Phosphokinase (CPK) enzyme in the blood [38]. Normally, CPK is an enzyme that is found in the heart, brain, and skeletal muscles [7, 13] but the increased levels of CPK in the blood can be possible when the sarcolemmal is damaged [7, 38]. Knowing the fact that the movement pattern of plyometric depth jump training puts athletes at the risk of getting injury, it is very necessary to determine the indicators as early as possible so as to prevent the occurrence of a more severe muscle damage. This is done by measuring the Creatine Phosphokinase (CPK) enzyme. And in relation to this, the research is conducted to determine: the effectiveness of plyometric depth jump training on explosive power of leg muscle, muscle strength, flexibility, and the CPK levels of basketball athletes.

Considering all these, the research questions are as follows:

1. How significant is the difference between the effect of plyometric depth jump and plyometric rim jump training on the leg muscle strength of basketball athletes?
2. How significant is the difference between the effect of plyometric depth jump and plyometric rim jump training on the leg flexibility of the athlete?
3. How significant is the difference between the effect of plyometric depth jump and plyometric rim jump training on the explosive power of the leg muscles of basketball athletes?
4. How significant is the difference between the effects of plyometric depth jump and plyometric rim jump training on the CPK level of basketball athletes?
5. This study aims at providing the basketball coach some of the basic things he needs to know which is the practical significance of the research to improve the performance of basketball athletes.

The specific purpose of this study is to compare between:

a. The effect of plyometric depth jump and plyometric rim jump training on the leg muscle strength of basketball athletes.
b. The effect of plyometric depth jump and plyometric rim jump training on the leg flexibility of the athletes.
c. The effect of plyometric depth jump and plyometric rim jump training on the legs muscle explosive power of basketball athlete.
d. The effect of plyometric depth jump and plyometric rim jump training on the CPK level of basketball athlete.

For a better understanding, there is need to explain the variables in this study.

A. Plyometric Depth Jump Training

Plyometric depth jump training is an exercise used to increase the explosive power of leg muscle. It is performed by combining the strength and speed of leg muscles using a plyometric box jump. This research used Chu (1992) method to measure the plyometric depth jump training. According to this method, plyometric depth jump training is done for 6 weeks, and 3 times a week, with each session taking 90 minutes.

B. Plyometric Rim Jump Training

Plyometric rim jump training is one of plyometric training undergone by basketball athletes. The characteristic of this training is the use of basketball ring without any supporting tool. [6, 8, 13] As put by Gred, the movement pattern of rim jump training is as explained below:

1. Athletes will stand under the basketball ring of 3.05m high
2. Without any initial movement, athletes will do jump movement and try to touch the ring.
3. Then, athletes land on their two feet. When their feet touch the ground, athletes do fast jump movement trying to touch the ring.
4. The intensity and volume of this training is based on the athlete's capability.

C. The Explosive Power of Leg Muscles

The explosive power of leg muscle is the ability of the leg muscles to do vertical jump. The ability of explosive power of leg muscle is measured by a vertical jump test, expressed in centimeters (cm). Vertical jump test score of basketball athletes: ≥ 70cm (categorized as perfect)

D. Leg Muscles Strength

Leg muscle strength is the ability of the leg muscle or a group of leg muscles to exert tension on a load. Leg muscle strength is measured using a leg dynamometer and expressed in kilograms (Kg). The leg dynamometer test score of a basketball athlete is ≥ 143.5 kg (categorized as perfect).

E. Leg Muscles Flexibility

Leg flexibility is the ability of the legs to move in joint spaces. It is measured by the sit and reach test, expressed in centimeters (cm). The sit and reach test score of basketball athletes: ≥ 24 cm (categorized as perfect)

F. Creatine Phosphokinase (CPK) Levels

Creatine Phosphokinase (CPK) is an enzyme in the circulatory system which is an indicator of muscle cell damage due to overloading. CPK level is measured using a spectrophotometer and expressed in units per liter (U/L). The normal CPK level in the blood: 22-198 U/L

II. METHODS

A. Research Design

This is a pre-posttest field experiment research in the discipline of Sports Physiology and Health, followed by blood tests in the laboratory.

B. Time and Place of Research

This research took place at Basketball Field Campus B State University of Jakarta, Jl. Pemuda no. 10, Rawamangun East Jakarta. The study was conducted for 9 weeks specifically from September 2011 to November 2011.

C. Research Subjects

The research subject were chosen among 80 athletes population (N) from basketball club division II DKI Jakarta which is part of PERBASI DKI Jakarta. Rounded up to 22 basketball athletes. The subjects have inclusion and exclusion criteria, which are:

1) Inclusion criteria:
   - Male < 25 years old, a basketball athlete of division II DKI Jakarta.
   - Have a good physical fitness based on body mass index (which is the result of their body weight (kg) divided by their height (m2). This should be 18-23.
   - Have a good health and wellness in which their vital signs (blood pressure, respiratory rate, pulse rate, and temperature) are within normal limits.
   - Registered as an active member of the State University of Jakarta basketball club.
   - Not doing any physical activity for a week before the research is conducted to avoid fatigue
2) Exclusion criteria:
   - The subjects that did not fully participate in the research procedure.
   - The subjects that had health problems or had injury during the research period, thus disrupting the study schedule.

D. Research Instruments

The instruments used in this study include:

- Forms of Participants' Informed Consent.
- Forms of personal data and examination results.
- Body weight scales to measure weight.
- Height scale to measure height.
- Sphygmomanometer to measure blood pressure.
- Stethoscope to count heart rate then compare it to the pulse at the wrist.
- Stopwatch to measure time.
- Leg dynamometer to measure leg muscle strength.
- Flexi meter sit and reach to measure the flexibility.
- Vertical jump instrument to measure leg muscle power.
- Tape measure to measure distance or length.
- Whistle as a start sign.
- Writing Tools.
- Clipboard
- Spectrophotometer

E. Data Collection

1) Data Collection Procedures and Techniques

Before starting the research, the subjects were briefed on the purpose and the procedures of the study. Each group of subjects performed physical measurements that includes weight, height, resting pulse count, and blood pressure, prior to the treatment (plyometric depth jump training). Then the subjects of both experimental groups warmed up for 15 minutes, after which the ability of the predominant physical components (explosive muscle leg power, muscle strength, and flexibility) on them were measured. The measurement of leg muscle strength using leg dynamometer; the flexibility of the leg muscles using flexi meter sit and reach test method; and the explosive muscle leg power using the Vertical Jump method. After that, the research subjects rested for 15 minutes. Then the activity proceeds with 1 session of plyometric depth jump and rim jump training. 24 hours after doing the training, the subject's blood samples were taken as much 5 cc as a sample to measure Creatine Phosphokinase (CPK) enzyme levels. Then the experimental group was subjected to the plyometric depth jump and the rim jump training for 6 weeks (= 18 practice sessions), with each training session lasted for 90 minutes consisting of warming up (20 minutes), core training (50 minutes) and cooling down (20 minutes). After 6 weeks of training, another set of measurement were taken like the first ones.

2) Schedule of data retrieval time

The data were collected two times, which are:

- Pre-Test data retrieval: September 2011.
- Post Test data retrieval: October 2011.

F. Data Analysis Technique

The data were analyzed using SPSS V.16.0 with the procedures as follows:

1) Normality Test

Normality test using Kolmogorov-Smirnov ($p \geq 0.05$) is to determine the mean of the normal or non-normal distribution of data. Parametric analysis is used when the data is normally distributed while nonparametric analysis is used when the data is not normally distributed.

2) Homogeneity Test

Homogeneity test between groups using Levine test ($p \geq 0.05$) is to determine whether there is variance between homogeneous groups or not. The results of this test will determine if the data analysis will be done using parametric or non-parametric statistics.

3) Dependent T-test

The dependent t-test ($p \leq 0.05$) was done to determine differences in the ability of the predominant physical components of basketball athletes (pre vs. post-test) (leg muscle strength, leg muscle flexibility, explosive power of leg muscle) and CPK level after plyometric depth jump training.

III. RESULTS

A. *The Comparison between The Effect of Plyometric Depth Jump and Rim Jump training on The Explosive Power of Basketball Athletes' Leg Muscles*

The results of measurement of the explosive power of leg muscles (cm) of basketball athletes before and after treatment in the plyometric depth jump training (group A) and rim jump training (group B) are listed in Appendix 4. From the paired t-test results, it is seen that there is an increase in the explosive power of leg muscles of basketball athletes after plyometric depth jump training (54.71±5.40 vs 60.50±5.35 p=0,000). An increase is also seen in the result of group B after being subjected to plyometric rim jump training (54.86±6.62 vs 58.86±6.33 p=0.000).

B. *The Comparison between the Effect*

To compare the effect of depth jump and rim jump on the leg muscle explosive power, an ANACOVA test was performed (p≤0.05). The result is shown in Figure 1. From the result, it is discovered that plyometric depth jump training increases the leg muscle explosive power of basketball athletes more than plyometric rim jump training (9.56% vs 6.80%).

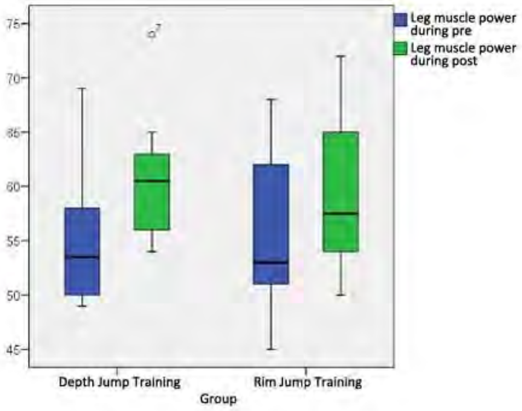

Fig. 1. The comparison between the effect of plyometric depth jump and rim jump training on the explosive power of basketball athletes' leg muscles of Plyometric Depth Jump and Rim Jump Training on Leg Muscle Strength of Basketball Athletes.

The results of the measurement of the leg muscles strength (kg) of basketball athletes before and after treatment in the plyometric depth jump training (group A) and rim jump training (group B) are listed. From the paired t-test results, it was found that basketball leg muscle strength after plyometric depth jump training was higher than before training (136.21±12.45 vs 152.71±13.77 p=0.000). The result of group B after undergoing plyometric rim jump training was also higher than before (132.5±14.8 vs 143.9±14.4 p=0.000).

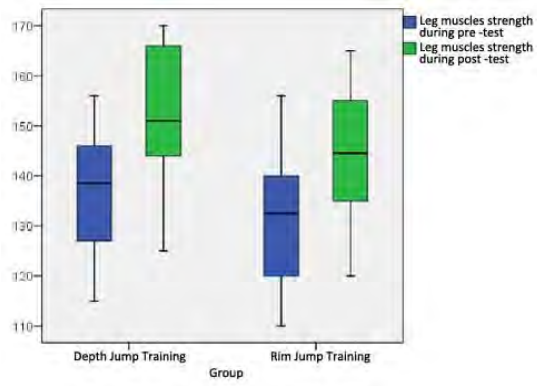

Fig. 2. The comparison between the effect of plyometric depth jump and rim jump training on leg muscle strength of basketball athletes.

C. *The Comparison between The Effect of Plyometric Depth Jump and Rim Jump training on Leg Flexibility*

The results of the measurement of the leg muscles flexibility (cm) of basketball athletes before and after treatment in the plyometric depth jump training (group A) and rim jump training (group B) are listed in Appendix 4. From the results of the paired t-test, it was discovered that the leg muscle strength after plyometric depth jump training was higher than before training (17.89±1.64 vs 19.32±1.90 p=0.000). And that of group B after being subjected to plyometric rim jump training was also higher than before (132.5±14.8 vs (18.81±1.95 vs 19.71±1.91 p=0.000). To compare the effect of both training on leg muscle strength, an ANACOVA test was performed (p ≤ 0.05). It is shown in Figure 3 that plyometric depth jump training increases the leg muscle flexibility of basketball athletes than plyometric rim jump training (7.39% vs 4.60%).

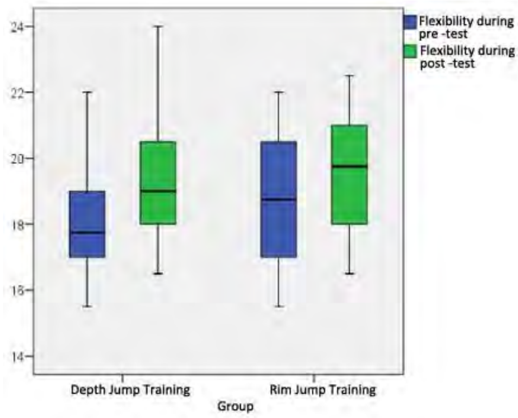

Fig 3: The comparison between the effect of depth jump and rim jump training on leg flexibility of basketball athletes.

D. *The Comparison between The Effect of Plyometric Depth Jump and Rim Jump training on CPK Level*

The results of measurement of the CPK levels (U/L) of basketball athletes before and after treatment in the plyometric depth jump training (group A) and rim jump training (group B) are listed. From the result of the paired t-test, it was discovered that the leg muscle strength after plyometric depth jump training was higher than before training (237.6±146.1 vs 329.4±182.9 p=0.006). However, the result of group B after undergoing plyometric rim jump training shows a decrease if compared with before training (356.3±214.2 vs 226.4±148.6 p=0.028).

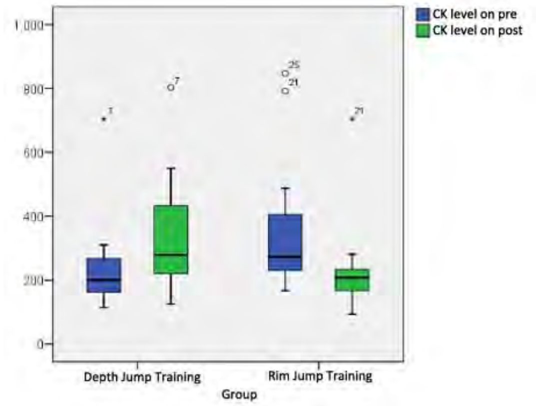

Fig. 4. The comparison between the effect of plyometric depth jump and rim jump training on CPK level of basketball athletes

IV. DISCUSSION

A. *The Comparison between The Effect of Plyometric Depth Jump and Rim Jump training on Leg Muscles Explosive Power, Leg Muscles Strength, and Leg Flexibility*

The results showed that there is an increase in explosive power of leg muscles (54.71 ± 5.40 vs 60.50 ± 5.35), in leg muscle strength (136.21 ± 12.45 vs. 152.71 ± 13.77) and in leg flexibility (17.89 ± 1.64 vs. 19.32 ± 1.90). The same results indicate that there is an increase in explosive power of leg muscles, leg muscle strength, and leg muscle flexibility after plyometric rim jump training. Increased leg muscles explosive power caused by the movement pattern of plyometric training which is dominated by fast-twitch muscle fiber contractions [6, 27, 28]. The combination of stretch and shortening movements of the muscles is performed quickly, occurs during plyometric depth jump and rim jump training. Fast-twitch muscle fiber is identical to rapid muscle contraction and low resistance to fatigue. In addition to rapid muscle contraction, the amount of calcium of fast-twitch muscle fibers released by the sarcoplasmic reticulum is faster and enzyme activity (myosin-ATPase) breaks ATP in the head of myosin (head part of the contractile protein) more [36]. There is a possibility that it increased after doing regular plyometric depth jump and rim training. Also, there is an increase in myoglobin, oxidative enzymes, and the size and number of mitochondria in muscle. The function of myoglobin in muscle is to bind oxygen. Physical activity that performed regularly will increase the number of myoglobin by 13% - 14% so that the ability of muscles to bind oxygen will also increase. Also, it will cause the size and number of mitochondria to multiply as an energy energy-producing source (ATP) in the cell. The more oxidative enzymes in the mitochondria, the more oxidative activity that will occur in the muscle, thus the amount of ATP will increase as well as the capacity of leg muscles explosive power [33, 37]. Increased leg muscles strength after plyometric depth jump and rim jump training occurs due to hypertrophy of muscle fibers, increased myoglobin, increased oxidation enzymes in muscle sarcoplasmic and increased number of mitochondria [33, 37]. Plyometric depth jump training includes exercise that uses inner load in order to increase the leg muscles explosive power by combining the strength and speed of the leg muscles. While performing plyometric depth and rim jump training, athlete's both feet land on the floor after making a vertical jump then their leg muscles bear the pressure of the body weight. The load that the leg muscles have to bear exceeds the actual weight because of the gravitational force of the earth. The muscles, then, overcome the weight of the load by involving more motor units, thus increasing the muscle fibers involved in muscle contraction, which leads to an increase of muscle strength and leg muscles explosive power in plyometric depth jump and rim jump exercises46. Plyometric depth jump and rim jump training that performed repeatedly affects the addition of contractile protein quantities, increased capillary density, the number of myoglobin, the number of mitochondria, oxidative enzymes, myosin filaments and increased connective tissue strength and ligaments around the muscle, causing muscle hypertrophy [21, 65, 66]. The flexibility of the legs increased after performing plyometric depth jump and rim jump training as they are a training method that maximizes the ability of leg muscles in performing eccentric contractions followed by concentric contractions (SSC) in a very short time. Chu revealed that the effects of muscle strain greatly determine the explosive power of leg muscles. While performing plyometric depth jump and rim jump training, leg flexibility is required to perform maximum vertical jumps6. Repetition of movements in plyometric depth jump and rim jump training will impact musculotendon strain ability on the leg joints and hamstring tendons hence increasing the leg's ROM (Range of Motion) and also the basketball athletes' vertical jump ability. Therefore, this what causes the increase of leg flexibility [8]. However, different condition happened with group who performed plyometric depth jump training. They experienced better improvement in case of leg muscle explosive power, leg muscle strength, and leg flexibility compared with those group who had plyometric rim jump training. This condition can be explained that while performing plyometric depth jump training, athletes' body receives greater mass (up to seven times higher than their actual body mass when their feet land on the ground) so more muscle fiber will be involved to overcome that sudden mass increase. This leads to the occurrence of bigger hypertrophy muscle [5, 6, 32]. This is explained that the sudden mass increase affects the addition of contractile protein quantities, increased capillary density, the number of myoglobin, the number of mitochondria, oxidative enzymes, myosin filaments and increased connective tissue strength and ligaments around the muscle, causing muscle micro trauma [21, 65, 66]. The occurring micro trauma provokes muscle to regrow, increases filament, and expands muscle volume as response to the training undergone. This is what causes the increase of leg muscle explosive power, strength, and flexibility of the group with plyometric depth jump training higher than one with plyometric rim jump training. From the elaboration above, it can be concluded that plyometric depth jump training is greater at increasing leg muscle explosive power, strength, and flexibility compared with plyometric rim jump training. The Comparison between The Effect of Plyometric

Depth Jump and Rim Jump training on CPK Level The result of this study shows an increase of CPK level after plyometric depth jump training (237.6±146.1 vs 329.4±182.9). This result indicates that there is a decline of CPK level by 27.88% after plyometric depth jump training. Meanwhile, a decrease of CPK level by 57.40% is shown after plyometric rim jump training (356.3±214.2 vs 226.4±148.6). The decline of CPK level after doing plyometric depth jump training happens as this type of training combines both leg muscle eccentric and concentric contraction which are undergone in high intensity and explosive movements [6, 8, 15, 28]. Constant movement with high intensity would cause mechanical stress on muscle fiber. Submaximal weight usually influences the structural reorganization. Meanwhile, Supramaximal stimulus often causes cytoskeleton tissue rupture [53]. Mechanical stress provokes intracellular change which is the result of overstretching and causes sarcomere rupture. This results in muscle injury which happens when CPK leaks out from muscle cells into blood circulation system that can be identified as muscle injury [67].

Besides, because the movement pattern of plyometric depth jump and rim training is done within a short time, the predominant energy source that supports this activity is from the anaerobic metabolism, alactacid and lactacid [1, 2]. Alactacid contains CPK that functions as a catalyst to produce ATP from creatine phosphate when the muscle experiences maximum contraction within a short time [1, 2]. On the other side, lactacid produces lactic acid during the occurrence of the anaerobic metabolism prompt the increase of lactic acid level in muscle cells that lead to the damage of sarcomere, thus CPK leaks out from muscle cells into blood circulation system. The level of skeleton's enzyme serum is the marker of the physiological status of tissue and the occurrence of skeleton's muscle damage [2, 21, 54]. This aligns with what experts suggest that the high level of CPK serum in blood circulation depends on sarcoma damage, either caused by intense training or muscular pathology and intense training can worsen skeleton muscle cells on sarcomere level and Z-line that result in the increase of CPK level. This explains how CPK level increases during plyometric depth jump and rim jump training [53, 54]. The high increase of CPK level after performing plyometric depth jump training occurred as the mass transferred to leg muscle could raise by up to seven times higher than body mass so the increase level of micro trauma also was also higher if compared with the condition after undergoing plyometric rim jump training. This agrees with what experts said that when training intensity is levelled up from light to medium, muscle fiber does not experience cell membrane permeability change. However, if training intensity is continuously increased, muscle fiber can experience permeability change and enzyme release. When the increase of training intensity exceed muscle ability, CPK is released from muscle cell into interstitial fluid then absorbed by lymphatic system and circulated in blood circulation system. This what makes the increase of CPK level after performing plyometric depth jump training higher than plyometric rim jump training [54]. Meanwhile, the other group who performed plyometric rim jump training experienced a decline of CPK level. The decline of CPK level occurred as the training intensity was lower than plyometric depth training. The movement pattern done by this group was repetitious with involving only the athlete's actual body mass, different with plyometric depth jump training group who could experience a sudden mass increase up to seven times greater than their actual body mass when they jump from plyometric box. This is supported by the result of this study which indicates a decline of CPK level after undergoing plyometric rim jump training (356.3±214.2 vs 226.4±148.6).

Other factors that could be responsible for decline in CPK level after training could be because the body has adapted after 3 weeks of training that prompted the increase of muscle strength and by the low training intensity. According to Brancaccio, CPK level on people who do regular sports training or who are trained would not experience significant increase after doing the training, different from those who do not train [54]. This may be caused by the process of body's adaptation to the regular training. From the elaboration above, it can be concluded that plyometric depth jump training is greater at increasing CPK level than plyometric rim jump training as depth jump training requires higher training intensity.

V. CONCLUSIONS

A. General Conclusion.

Plyometric depth jump training increases the leg muscle explosive power, strength and flexibility, and CPK level than plyometric rim jump training. However, performing plyometric rim jump training resulted in a decline of CPK level though an increase in the leg muscle explosive power.

B. Specific Conclusions

1. Plyometric depth jump training increased the leg muscle explosive power (54.71±5.40 vs 60.50±5.35), strength (136.21±12.45 vs 152.71±13.77) and flexibility (17.89±1.64 vs 19.32±1.90)
2. Plyometric rim jump training increased the leg muscle explosive power (54.86±6.62 vs 58.86±6.33), strength (132.5±14.8 vs 143.9±14.4), and flexibility (18.81±1.95 vs 19.71±1.91).
3. Compared with plyometric rim jump training, plyometric depth jump training is greater at increasing leg muscle explosive power (9.56% vs 6.80%), strength (10.80% vs 7.89%) and flexibility (7.39% vs 4.60%).
4. There is a greater increase of CPK level in plyometric depth jump training than rim jump training (27,88% vs -57,40%).

C. Suggestions

1. Coaches are encouraged to use plyometric depth jump and rim jump training to increase leg muscle explosive power, leg muscle strength, and leg flexibility of their athletes.

2. Muscle strength, and leg flexibility, it is suggested that athletes perform plyometric depth jump training.
3. The movement pattern of plyometric depth jump training have risks of an injury, therefore, it is recommended that all the basketball athletes perform the stages of training according to the normal schedule.
4. The measurement of CPK levels should be done periodically in order to know the basketball athletes' level of injury.
5. Further research should be done on other forms of plyometric training that can increase muscle explosive power, muscle strength and flexibility of basketball athletes but does not increase the risk of injury.

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