Dama International Journal of Researchers (DIJR), ISSN: 2343-6743, ISI Impact Factor: 1.018
Vol 2, Issue 7, July, 2017, Pages 07 - 11, Available @ www.damaacademia.com

The Effect of Dynamic and Static Contraction on Increasing Explosive Power Legs Muscle

Hendrik[1], Arpandjam'an[2], Yonathan Ramba[3]
[1,2&3]*Department of Physiotherapy, Health Polytechnic of Ministry of Health in Makassar, Indonesia*

Abstract
Muscle explosive power is one of the physical components needed in various sports and is the greatest muscular power in the shortest period of time completing the task. Muscle explosive power always involves the strength and speed of explosive muscle contractions and involves spending the maximum muscle strength in a fast time. This study aimed to determine the effect of dynamic and static contraction exercises on increasing the muscle limb power by using quadriceps bench. This research was conducted at Department of Physiotherapy, Health Polytechnic of Ministry of Health in Makassar. The research type was quasi-experiment. The research sample was 30 people divided into two groups, the group was given dynamic contraction training and another group was given static contraction training to increase the explosive muscle strength of the limbs, so this research used pre-post test control groups design. Measurement of explosive muscle limb power was done by using vertical jump test. The result of paired t-test showed a significant difference ($p < 0.05$) with the ability of vertical jump test before the training of dynamic contraction 40.20 ± 4.960 and after training 48.73 ± 5.378. Similarly, static contraction training showed significant differences ($p < 0.05$) with the ability of vertical jump test before static contraction training 39.53 ± 4.438 and after training 46.87 ± 5.181. The independent t-test showed no significant difference ($p > 0.05$) between dynamic contraction training with static contraction training and vertical jump test. The conclusion of this study is that there is no difference in the effect of giving quadriceps bench dynamic and static technique on increasing the vertical jump test. However, judging from the average difference in value, the quadriceps bench granting of dynamic techniques is greater than the quadriceps bench of static techniques in increasing the vertical jump test of the legs.
Keywords*: Dynamic and static contractions, Muscle explosive, Quadriceps bench exercises, vertical jump test*

I. INTRODUCTION

Muscular force is the ability of a person to use the maximum power deployed in the shortest time. Muscle power is a combination of strength and speed. The stronger and faster the muscles work, the better the explosive power of a person's muscle (Umasugi, et al., 2012). Muscle explosive power is a combination of strength results with speed so it requires good physical fitness by developing a predominant energy anaerobic system (Bompa, 1999). Strength plays a key role in the production of explosive power and if not maintained by exercise may result in a decrease or no change in the production of explosive power. Strength refers to a load of x acceleration while the velocity is the distance/time of movement (Kisner, 2012).

Because muscle explosive power requires strength and speed, then muscular explosive power is essential in improving sports performance. In relation to that, it is necessary to practice that can improve performance so that it demands a coaching effort that can be done to help improve the ability of speed by improving endurance through anaerobic endurance training and fast strength training. However, to achieve this ability must first take several stages (period), known as bio motor periodization.

Many exercise techniques can be applied to increase muscle explosive power, either exercise with isometric motion or exercise with isotonic movement. The practice of quadriceps bench is one of the exercise techniques by using the load from outside the body so that the muscles can contract both isometric and isotonic. Exercise with isometric or isotonic contractions can increase muscle strength as an effect on muscle power and endurance. Concentric muscle action does not produce much strength (Hoffman, 2012). However, the explosive power output can be increased considerably when eccentric and concentric motions are used together to take advantage of the elastic properties of muscles in the stretch-shortening cycle. Increased strength of a muscle due to increased power and muscle endurance so that muscle explosive power increases (Satrya, et al., 2007)

II. METHODS

The research was conducted at Department of Physiotherapy, Health Polytechnic of Ministry of Health in Makassar, Indonesia. This study was designed using quasi-experimental design. This study aimed to measure the influence of dynamic and static technique exercises using quadriceps bench to increase the muscle limb power explosion between treatment groups and control groups in the students of Department of Physiotherapy, Health Polytechnic of Ministry of Health in Makassar. Measurements were made on explosive power of leg muscles

before and after dynamic and static engineering exercises using quadriceps bench. This research was designed using pre-post test control groups design.

The population of this research was the students of Department of Physiotherapy, Health Polytechnic of Ministry of Health in Makassar, Indonesia. The sample of this research was the students of Department of Physiotherapy, Health Polytechnic of Ministry of Health in Makassar, Indonesia, male, non-smoker, and not being disturbed by the musculoskeletal system, resulting in a total of 30 subjects.

Data obtained from the measurement of explosive muscle limb power with vertical jump test technique in both groups (static and dynamic exercise groups). Both groups were measured before and after dynamic and static contraction exercises with quadriceps bench with 10 RM load at 10 reps with exercise frequency 3 times a week for 2 months. The data obtained by normality test. Normality test resulted obtained normal data, so proceed the parametric test. To analyze the treatment group data before and after static and dynamic exercise with quadriceps bench used paired t-test and to compare between the two exercise groups using independent t-test.

III. RESULTS

Table 1 shows the value of explosive muscle limb power by measuring vertical jumps before and after dynamic exercise by using quadriceps bench at 10 RM load with 10 reps and training frequency 3 times a week for 2 months.

Table 1. Comparison of Vertical Jump Test Value Before and After Given Dynamic Contraction Exercises With Quadriceps Bench

Dynamic Contraction Exercises				The difference of mean		t	p
Before		After					
Mean (cm)	SD (cm)	Mean (cm)	SD (cm)	Mean (cm)	SD (cm)		
40.20	4.960	48.73	5.378	8.53	0.915	-36.101	0.000

The result of paired t-test showed the average value of vertical jump test before given dynamic contraction practice of 40.20 + 4.960 cm and after given the dynamic contraction exercise of 48.73 + 5.378 cm with an average difference of 8.53 + 0.915 cm and t value equal to -36.101 with significant level equal to 0,000 (p-value <0,05), which means that there was significant differences in the effect of vertical jump test before and after dynamic contraction exercises are given using quadriceps bench. Thus it could be concluded that the provision of dynamic contraction exercises using quadriceps bench could increase the explosive muscle power of the legs.

Table 2 shows the value of explosive muscle limb power by measuring vertical jumps before and after static exercises using quadriceps bench with 10 RM load at 10 reps with training frequency 3 times a week for 2 months. Measurements were performed to determine the difference in mean limb muscle explosive power before and after static exercise.

Table 2. Comparison of Vertical Jump Test Value Before and After Given Static Contraction Exercises With Quadriceps Bench

Static Contraction Exercises				The difference of mean		t	p
Before		After					
Mean (cm)	SD (cm)	Mean (cm)	SD (cm)	Mean (cm)	SD (cm)		
39.53	4.438	46.87	5.181	7.33	0.900	-31.567	0.000

The result of paired t-test showed the average value of vertical jump test before given static contraction exercises of 39.53 + 4.438 cm and after given the static contraction exercise of 46.87 + 5.181 with an average difference of 7.33 + 0.900 cm and the value of t -31.567 with a significant level of 0.000 (p-value <0.05), which means that there was a significant difference in the effect of vertical jump test before and after being given static contraction exercises using quadriceps bench. Thus it could be concluded that the provision of static contraction exercises using quadriceps bench could increase the explosive power of the leg muscles.

Table 3 shows the ratio of Vertical Jump Test between groups after exercise using quadriceps bench with 10 RM load at 10 reps with exercise frequency 3 times a week for 2 months. Measurements were performed to compare the vertical jump test between groups given contractionary dynamic exercises with static contractions by using quadriceps bench.

Table 3. Comparison Between Dynamic and Static Contractions to Vertical Jump Test Value

Type of Exercise				t	p
Dynamic Contractions		Static Contraction			
Mean (cm)	SD (cm)	Mean (cm)	SD (cm)		
48.73	5.378	46.87	5.181	-0.968	0.341

The result of independent t-test obtained the value of vertical jump test after given dynamic contraction exercise equal to 48.73 + 5.378 cm and value after given static contraction exercise equal to 46.87 + 5.181 cm at t value equal to -0.968 with significant level 0.341 (p-value >0.05). This showed no significant difference in effect between groups of dynamic contraction exercises with static contraction exercises on increasing the muscle tone of the leg muscles. When viewed from the average value of increase between the two groups, the average increase in the group of dynamic contraction exercise was higher that is 8.53 + 0.915 cm compared to the average increase in the static contraction exercise group is 7.33 + 0.900 cm. Thus it could be concluded that the provision of dynamic contraction exercise was better than the static contraction exercise by using quadriceps bench against increasing the muscle limb power. For more details can be seen in Figure 1.

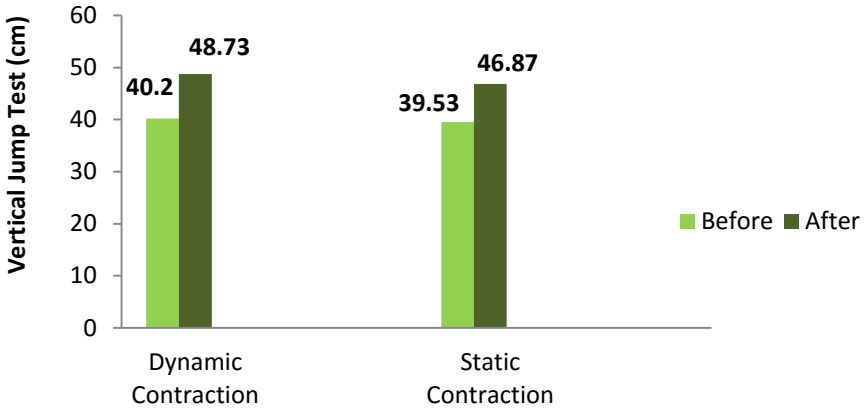

Figure 1. Comparison of Vertical Jump Test Values Between Dynamic Contractions With Static Contraction Before and After Exercise

IV. DISCUSSION

In this study, the sample was divided into two groups, namely the group given the dynamic contraction exercise and the group who were given static contraction exercises using quadriceps bench. To ensure that the muscle limb power can be used as a parameter of the success of both forms of exercise, prior to the exercise, the explosive power legs muscle of the subjects in both groups was measured (pretest). Then the two groups were given a practice with dynamic contraction and static contraction using quadriceps bench with 10 RM load at 10 reps with exercise frequency 3 times a week. Then after 2 months of exercise, measurements of explosive limb muscle power were observed in both groups (posttest). This was to determine the differences in explosive muscle power of both groups before and after exercise.

Based on the data analysis, there was a significant difference in limb muscle explosion before and after dynamic contraction exercises with quadriceps bench at 10 RM load at 10 repetitions with exercise frequency 3 times a week for 2 months. The occurrence of differences in explosive power of leg muscles before and after dynamic contraction exercises can be explained by the interpretation that, when performing a dynamic contraction will cause muscle strength to contract. Strength is one of the factors that affect the explosive power of the muscle itself. So the greater the force or energy the muscles generate when contracting and followed by high muscle contraction velocity, the greater the resulting muscle burst, the high muscle contraction will stimulate an increase in explosive muscular power (Kisner, 2012). Exercise with dynamic contraction will produce excellent strength and speed to increase muscle explosive power. Exercise with dynamic contraction can also be done with high-intensity exercise with fast repetition (Lawrenson, 2008). Dynamic contractions provide a great stimulus to actin filaments and myosin in muscles so as to produce speed and strength as a major component of muscular explosive

power. Due to the provision of muscle contraction dynamic exercises increased the mass so that the muscle hypertrophy or enlarged (Guyton and Hall, 2007). Besides the muscles experiencing hypertrophy, dynamic contraction exercises also lead to an increase in the number of mitochondria quickly so that the physiologically better muscle in the taking of oxygen (Nala, 2002).

Based on data analysis, there was a significant difference in limb muscle explosion before and after static contraction exercises with quadriceps bench at 10 RM load at 10 reps with exercise frequency 3 times a week for 2 months. The occurrence of differences in explosive power of the leg muscles before and after static contraction exercises can be explained by the interpretation that, at the time of static contraction will cause a large burden on the muscle groups that give birth to the strength to resist the burden from the outside. This is in line with opinion Russell (2006) Which states that the basis for the formation of explosive power is power. Increased strength can be achieved by the provision of load training. Provision of weight training with quadriceps bench can increase leg muscle strength. This opinion is in line with opinion Wilmore (1999) which states that physiological adaptation of muscles will occur in continuous loading exercises. Physiological adaptations that occur are increased muscle size and increased motor unit recruitment. The increase in both components indicates an increase in strength level and increased strength level will also be followed by an increase in leg power. In addition to the physiological adaptation process, muscle strength is also influenced by factors that affect the strength of the anatomical and physiological aspects of the skeletal muscle fiber, large skeletal muscle, the number of cross-bridge involved. Physiological biochemical aspect is energy metabolism system especially anaerobic metabolism. Kinesiological biomechanical aspects such as joint angle, strength, the interaction of position between body parts with the overall style mechanics system (Kumar, 2004; Park Sheng, 2007; Fox, 2011).

Based on data analysis, there was no significant difference in explosive power of leg muscles between groups given dynamic contraction exercises with groups given static contraction exercises. Leg muscle explosive power in both intervention groups was no difference due to dynamic contraction exercises as well as static contraction exercises, both of which can produce strength in the trained muscles as a major factor resulting in an increase in muscular explosive power. Exercise with dynamic and static contractions using quadriceps bench can produce high-intensity motions and fast and explosive repetitions with greater resistance loads of trained muscle ability (Satriya, 2007; Lawrenson, 2008). The impact of exercise on both types of contractions leads to an increase in muscle mass (Guyton and Hall, 2007).

At the mean difference between the two types of exercise, the average value of dynamic contraction exercise is better than the static contraction exercise. Differences between the two types of contraction exercise occurs because in the practice of dynamic contraction changes in length and short in muscle fibers always change so that can be obtained the external and internal load to the maximum, whereas in static contraction exercises the muscle fibers are in static position without undergoing changes when fighting the outside load. Exercise with dynamic contractions in addition to producing strength also produces optimum speed, whereas in static contraction exercises only produce optimum strength. As a result of the reactions generated in both exercises, dynamic contraction exercises can lead to improved receptor response in the muscle, that is muscle spindle response and golgi apparatus. Muscle spindles are receptors that send signals about the rate of muscle strain and muscle length, while the Golgi organ is a sensory receptor that sends information about muscle tension. Both elements are very important in influencing the explosive power of a muscle (Bompa, 1999; Sharkey, 2003).

V. CONCLUSION

The results of the study can be summarized in the differences in explosive muscle power before and after the provision of dynamic and static contraction exercises. There is no difference in the effect of giving quadriceps bench a dynamic and static contraction technique to an increase in explosive muscle leg power. However, in terms of the difference in mean, the quadriceps bench technique is more dynamic than the quadriceps bench static technique on increasing the muscle limb power.

ACKNOWLEDGEMENTS

Thank you to the Director of Makassar Health Polytechnic who has given the opportunity to the researcher to carry out the research. Acknowledgments were also conveyed to the Head of the Physiotherapy Department of Makassar Polytechnic Health who had facilitated the completion of our research.

REFERENCES

1. Bompa, 1999, *Power Training for Sport*, Canada, Mosaic Press.
2. Fox, 2011. *Human Physiology*, 8th ed, MC Graw Hill, New York, pp. 10 – 11, 360 – 377.
3. Hoffman, 2012. *Functional Isometric Contraction*, Create Space Independent Publishing Platform.

4. Guyton AC, Hall JE, 2007, *Textbook of Medical Physiology*, Edisi 10. Philadelphia: W.B. Saunders Company; pp. 67-79 and 80-6.
5. Kisner, 2012. *Therapeutic Exercise Foundations and Techniques*, United States Of America: F. A. Davis Company.
6. Kumar, 2004. *Muscle Strength*, CRC Press, New York. pp. 45 – 5, 394 – 396.
7. Lawrenson, 2008, *The Super Toning Training Routine*. http://www.muscleandstrength.com.
8. Nala, N, 2002. *The Principle of Physical Sports Training*, KONI, Denpasar, Bali
9. Park, Leonard, Sheng Li, 2007. Perception of Finger Forces Within the Hand After Index Finger Fatiguing Exercise, *Journal Experimental Brain Research*, vol.182, no. 2, pp. 169–177.
10. Russell, 2006. Innovative Interventions to Promote Physical Activity in Youth, *Medicine & Science in Sports & Exercise Journal*, Volume 38 - Issue 5 - p 68.
11. Sharkey, Brian J, 2003. *Fitness and Health*, Brian J. Sharkey, Pt. Raja Grafindo Persada. Jakarta.
12. Satriya., Sidik, S., Imanudin, I, 2007. *Sports Coaching Methodology*. Faculty of Sport and Health Education, UPI, Bandung.
13. Umasugi, Patellongi, Nawir, 2012. Effect of Exercise Period General Preparation Against Explosive Muscle Limb Ability Shadow Athlete PON XVIII KONI South Sulawesi.
14. Wilmore, 1999. *Physiology of Sport and Exercise*, 2nd ed. Human Kinetics, Texas.