

## **EFFECT OF MANIPULATION COMPLEX TRAINING (PYRAMID COMPLEX TRAINING & SQUARE COMPLEX TRAINING) TO IMPROVING AGILITY**

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This study aims to prove the effect of complex training manipulation on agility in non-athletes aged 18-20 years. This research is included in quasi-experimental research. Research design using pretest post test group design. The population of this research is the students of Sport education coaching program. Samples were taken using Isaac and Michael's formula with a significance level of 5%. Subjects were divided into 2 groups, namely PCT and SCT groups. The PCT group was treated with a combination of 8 RM, 6 RM, 4 RM and plyometric training with pyramid system (lateral single leg jump 6 contacts, 8-contact side jacks, box's jump 10 contacts, twist front jump 12 contacts and twist tuck jump 14 contacts) . The SCT group was treated with a combination of 8 RM, 6 RM, 4 RM and plyometric training with square system (single leg jump 10 contacts, 10-contact side jacks, 10-contact front jacks, 10 hard contacts and 10 contact tuck jumps). The training was conducted three weekly training sessions for 7 weeks. All groups were given preliminary and final tests. Initial tests were performed 40-48 hours before the treatment trial, and the final test was conducted 48 hours after treatment. The agility test uses an electric side step (TKK 1272 Beam Type Repetitive Side Stepping Tester). Analysis of research data with t test. The results showed that (1) There was a significant effect of PCT manipulation on agility, with significance value of  $0.000 < 0.05$  and percentage increase of 14.66%. (2) There is a significant effect of SCT manipulation on agility, with a significance value of  $0.000 < 0.05$  and a percentage increase of 10.58%. (3) There was a significant difference between PCT and SCT group of agility, with significance of  $0.022 < 0.05$ , so it can be concluded that PCT group is more effective than SCT group for agility improvement.

**Key Words:** Pyramid Complex Training, Square Complex Training, Agility

### **INTRODUCTION**

To achieve high achievement in competitive sport, prime physical condition is required in accordance with the needs and demands of the sport. Prime physical conditions should be the need of every athlete, especially for sports that require long-lasting heavy performance. Many advantages are obtained from the prime physical condition is easy in mastering complex skills, reduce the risk of injury, maintain physical performance, accelerate post-exercise recovery and increase confidence.

In sports training biological and tissue systems are conditioned by applying increasingly heavy physical demands based on the development of athlete's physical condition. To achieve these objectives requires a proper training approach. In training terminology commonly called the training method. According to the Oxford Dictionary method is one form of procedure for achieving or approaching

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something, especially a systematic one. Training is an act of teaching a particular skill or type of behavior (Oxford dictionary). Training according to Bompa, (2009) is a systematic repetition to achieve maximum performance. Training method is a systematic repetition procedure to master the skill or achieve the maximum functional qualities of the body. With the right training method, the body will experience adaptation in the form of enhancement of functional ability of the body so as to perform heavy performance in a relatively long time.

Any physical activity, especially exercise is always faced with the possibility of injury so that will have an impact on the disruption of physical activity, psychic, and achievement. One of the most commonly injured limbs is the ankle joint. The legs are bearing the weight of the whole body, are under tremendous pressure. In many sports, the foot absorbs shift and the loading force is very large, sometimes reaching more than 5 times the weight.

Studies have shown that female athlete injuries are 2-3 times more frequent than male athletes to maintain anterior cruciate ligaments (ACLs), especially in soccer and basketball programs (Yap, *et al.*, 2000). ACL is one of the major ligaments in the knee capsule that serves to maintain knee stability and connect the back of the femur to the front of the tibia. The ACL injury usually occurs when an athlete twists the knee beyond the normal range of rotating, cutting, jumping or running motion. These injuries tend to increase when engaging an increasingly explosive movement difficult. The top level competition requires an increase in neuromuscular conditioning because the athlete must move vertically, laterally, linearly, more precisely, explosively and reactively. The ACL is a ligament inside the joint that maintains knee joint stability. ACL injuries often occur in high-impact sports, such as soccer, futsal, tennis, badminton, basketball and martial arts. ACL can handle great power with little or no problem. However, if the knee receives great strength and the muscles can not help dampen the pressure, the ACL will take over all the loads, and allow for tearing.

Common sports-related injuries are ankle sprain, about 10% to 25% (Schaefer, and Sandrey, 2012), 40% (Yaggie and McGregor, 2002) of all sports injuries, most injuries occur at the end of activities when participants are tired (Yaggie and McGregor., 2002). It is possible that most of these injuries result from joint instability due to musculature fatigue. The relevance of fatigue to joint stability is evidenced by the relationship between postural control and isokinetic endurance of knee muscle groups (Yaggie and McGregor, 2002). Physiologically fatigue defined the inability to continue the exercise at a certain intensity. In all sports and exercises, the incidence of fatigue will vary depending on the person's fitness level, exercise intensity, and environmental conditions (eg. heat, humidity and altitude).

Most athletes maintain and improve physical conditions simply by taking part in the sport they choose, not yet accompanied by exercises involving the analysis

of the motion that they are in. While upper level competitions require core muscle requirements, maximal leg muscle strength, stability, balance, lateral deformity, vertical leap, and higher reaction time. This quality can be improved through a combination of weight training and plyometric training. The plyometric exercise is the rapid deceleration of the mass immediately followed by the rapid acceleration of the mass in the opposite direction.

Complex training is one form of high intensity exercise that combines maximum strength training with explosive strength training, so that the training results will be able to improve the power and strength of athletes (Word, 2009). Complex training is an exercise method that aims to improve the athlete's physical condition by doing high intensity strength training followed (transfer) to plyometric exercises. Biomechanically there is a similarity of muscle and joint involvement between weight training with plyometric. Examples of 3-6 RM squats training followed by 8-12 repetition knee tuck jump exercises and bench press exercises 2-5 RM followed by 8 repetition clack push exercises (Mackenzie., 2000).

The modification of complex training by varying the repetition pyramid load training decreased from 8 repetition maximum (8 RM), (6 RM) and (4 RM) with ascending intensity not yet done much research. Most researchers use high intensity external resistance (1-3 RM) with constant methods. Similarly, with plyometrics, there is little research comparing plyometric pyramidal exercises (jumping to lateral, forward, sideways and twist), height of varied obstacles (20-50 cm), number of tiered contacts increased (6-12) and plyometric training square (jumping in the same direction with the same high hurdle and the same number of contacts). In addition, most of the complex training studies are applied to trained athletes. Complex training studies on the sample of poorly trained athletes have not been widely practiced. In this case, the student majoring in sports coaching Faculty of Sport Science YSU is mostly not an athlete so it is possible to be the subject of research.

Modified forms of explosive exercises such as jump up and down, side-jump, knee tuck jump, single leg jump, lateral jump and box jump either by normal jumping or twist will be the main study in this study. Single-leg training has many benefits and attention to injury prevention, rehabilitation, and performance improvement of sports programs. According to Boone, and Cook., (2006), sports movement skills in the field are dominated by gait cycles taking off from one foot and landing with one other foot appropriately to improve athlete performance.

## **METHODS**

This study included quasi experiment. The research design used was "Pretest-Post test Groups Design", the research design that contained pretest before being treated

and posttest after being treated, thus can be known more accurate, because it can compare with held before treatment (Sugiyono, 2007). This research has two variables, that is independent variable and dependent variable. The independent variables in this research are Training of Pyramid Complex Training (PCT) and Training of Square Complex Training (SCT), while the dependent variable is Agility.

The population in this research is the third semester (three) Department of Sports Coaching Education, Faculty of Sport Science Yogyakarta State University, age 19 to 20 years and not athlete, consist of 80 men. Simple random sampling method, 21 people were subjected to agility, then ranked and divided into 2 groups. As many as 11 people as PCT training group, 10 people as SCT training group. Instruments used to measure agility with side step Data analysis technique. Before stepping into the t-test, there is a requirement to be met by the researcher that the analyzed data should be normally distributed, therefore normality test and homogeneity test (Arikunto, 2006) are required.

## RESEARCH RESULTS AND DISCUSSION

The data in this research is agility. The result of pretest and posttest ability capability. Pretest and posttest data of PCT group agility capabilities as follows:

TABLE 1: PRETEST AND POST TEST GROUP PCT

| <i>No</i> | <i>Pretest</i> | <i>Posttest</i> | <i>Delta</i> |
|-----------|----------------|-----------------|--------------|
| 1         | 35             | 40              | 5            |
| 2         | 34             | 39              | 5            |
| 3         | 33             | 38              | 5            |
| 4         | 37             | 41              | 4            |
| 5         | 37             | 41              | 4            |
| 6         | 38             | 43              | 5            |
| 7         | 35             | 40              | 5            |
| 8         | 30             | 36              | 6            |
| 9         | 33             | 39              | 6            |
| 10        | 33             | 40              | 7            |
| 11        | 37             | 41              | 4            |
| Mean      | 34.7273        | 39.8182         | 5.0909       |
| SD        | 2.41209        | 1.83402         | 0.94388      |
| Minimal   | 30.00          | 36.00           | 4.00         |
| Maksimal  | 38.00          | 43.00           | 7.00         |

Data pretest and post test agility, SCT group as follows:

TABLE 2: PRETEST AND POST TEST OF SCT GROUP

| <i>No</i> | <i>Pretest</i> | <i>Posttest</i> | <i>Delta</i> |
|-----------|----------------|-----------------|--------------|
| 1         | 39             | 42              | 3            |
| 2         | 36             | 40              | 4            |
| 3         | 33             | 37              | 4            |
| 4         | 34             | 38              | 4            |
| 5         | 39             | 42              | 3            |
| 6         | 38             | 41              | 3            |
| 7         | 40             | 42              | 2            |
| 8         | 29             | 36              | 7            |
| 9         | 39             | 42              | 3            |
| 10        | 32             | 37              | 5            |
| Mean      | 35.9000        | 39.7000         | 3.8000       |
| SD        | 3.72529        | 2.45176         | 1.39841      |
| Minimal   | 29.00          | 36.00           | 2.00         |
| Maksimal  | 40.00          | 42.00           | 7.00         |

## Prerequisite Test Results

Normality test; The result summarizes the normality test presented in table 3 as follows:

TABLE 3: NORMALITY TEST RESULTS

| <i>group</i>            | <i>p</i> | <i>Sig.</i> | <i>result</i> |
|-------------------------|----------|-------------|---------------|
|                         |          | PCT group   |               |
| <i>Pretest Agility</i>  | 0,819    | 0,05        | Normal        |
| <i>Posttest Agility</i> | 0,886    | 0,05        | Normal        |
|                         |          | SCT group   |               |
| <i>Pretest Agility</i>  | 0,752    | 0,05        | Normal        |
| <i>Posttest Agility</i> | 0,687    | 0,05        | Normal        |

## Prerequisite Test Results, Normality test

From table 3 above it can be seen that all data have p value (Sig.) > 0.05, then the normal distributed variable.

Homogeneity Test. The results of homogeneity test of this research can be seen in table 4 as follows:

TABLE 4: HOMOGENITY TEST RESULTS

| <i>Group</i>                    | <i>Sig.</i> | <i>Result</i> |  |
|---------------------------------|-------------|---------------|--|
|                                 |             | PCT group     |  |
| <i>Pretest-Posttest Agility</i> | .266        | Homogen       |  |
|                                 |             | SCT group     |  |
| <i>Pretest-Posttest Agility</i> | .141        | Homogen       |  |

From table 4 above it can be that all data has p value (Sig.) > 0.05, so the data is homogeneous.

Hypothesis Test Results. Testing of research hypothesis is done based on result of data analysis and interpretation t test analysis. The sequence of results of the hypothesis testing is adjusted with the hypothesis, as follows: Hypothetical influence of Manipulation Complex Training on agility. The first hypothesis reads “There is a significant effect of PCT and SCT manipulation of agility”. Based on the analysis results obtained data in table 5 as follows:

TABLE 5: T-TEST RESULTS OF PRE-TEST AND POST-TEST OF PCT GROUPS

| <i>Group</i>                   | <i>Sig.</i> | <i>Result</i> |
|--------------------------------|-------------|---------------|
|                                | PCT group   |               |
| <i>Pretest-Posttest Agilty</i> | .000        | Significant   |

From the t-test results in the above table, it shows that the agility variability is significant at  $p:0,000 < 0.005$ , “There is a significant effect of PCT manipulation on agility, acceptable. Based on the above data shows that PCT exercise is appropriate to increase Agility by 5.09 seconds and increase percentage by 14.66%.

| <i>Group</i>                   | <i>Sig.</i> | <i>Result</i> |
|--------------------------------|-------------|---------------|
|                                | SCT group   |               |
| <i>Pretest-Posttest Agilty</i> | .000        | Significant   |

From the t-test results in the above table, it shows that the agility variability is significant at  $p 0,000 < 0.005$ , then the hypothesis reads “There is a significant effect of SCT manipulation on agility, acceptable. Based on the above data shows that PCT exercise is appropriate to increase Agility of 3.80 and percentage increase of 10.58%.

TABLE 6: TEST-TEST OF PCT GROUP AND SCT GROUP

| <i>Group</i>         | <i>Sig.</i> | <i>Result</i> |
|----------------------|-------------|---------------|
|                      | SCT Group   |               |
| <i>PCT-SCT group</i> | .022        | Significant   |

Based on the data in the above table, it shows that the significance value of  $0.022 < 0.05$ . Thus it shows a significant difference. So Hypothesis which sounds, there is significant difference between PCT and SCT group to agility, accepted. On average, the PCT group was better than the SCT group for agility.

## DISCUSSION

The results showed that PCT and SCT manipulation had a very significant effect, ( $p < 0,000$ ) on increased agility. Next observe the average increase in PCT

manipulation (5.09) or equivalent to 14.66% greater than SCT (3.80) or 10.58%. there was a significant difference between PCT and SCT groups with agility of  $0.022 < 0.05$  to observe the mean score, indicating that PCT group was better than the SCT group for agility. The results of this study need to be studied based on the theory and findings of previous researchers related to the variables in this study.

Based on theoretical study, Young & Farrow., (2006) agility is determined by two main factors, namely 1) perceptual and decision making and 2) change of direction speed. The first factor influenced four components of visual scanning, anticipation, pattern of recognition and knowledge of situation. The second factor includes technique, sprint speed and quality of leg muscles. Agility is a complex biomotor, influenced by physical and non physical. Therefore more discussion on physical quality is the second factor the speed of change direction.

As Young & Farrow pointed out, (2006) that the speed of change in direction is influenced by three important components namely 1) technique, 2) sprint speed and 3) quality of leg muscles. The ability to change the direction and speed of the acceleration is influenced by the position of the body adopted when running (technique). Leaning forward is required for acceleration, leaning backward for deceleration and stopping, and leaning sideways to produce lateral alteration.

Based on this theory, athletes who have good skills have the potential to have better agility. In this case the technical variables are considered the same because the sample of a homogeneous population of students majoring in education SSF YSU. 2) Quality of leg muscles, including three components, namely: limb strength, power, and reactive power. In theory good leg strength will increase reactive power. Reactive power is defined as the ability to change rapidly from eccentric to concentric phase in a sequence of stretch-shortening-cycle (SSC). The treatment in this study is a combination of weight training and plyometric. The weight training treatments of both groups (PCT and SCT) were the same with the APS method (ascending pyramid system) 8 RM, 6 RM and 4 RM so that the effect on the increase of leg muscle strength was assumed same. Plyometric training in the PCT group focused more on the manipulation of functional training (Verkhoshansky., 1986) and the SCT group more emphasis on the manipulation of amortization. Functional training in PCT group plyometric training involves twist, rotational, lateral, and integrated balance movements. This type of exercise involves acceleration, deceleration, and stabilization during multipurpose movements in all 3 areas (sagittal, frontal, and transverse), and must be proprioceptively challenged (Yep, *et al.* 2000). Theoretically these two forms of training will increase explosive strength. This is corroborated by the research of Miller *et al.* (2006) that subjects undergoing plyometric training were able to significantly increase time on both T-test and Illinois agility tests. Therefore, Miller found a positive relationship between plyometric training and improvement of both agility tests. In terms of treatment, the total time of plyometric exercise exercise of the SCT manipulation group has a

shorter time record than PCT training. If the same jump count is reached by a faster time, then the group with faster record time can be ascertained to have shorter contact time.

According to Dr. Michael Yessis that the jump should run within 0.15 seconds or less, 0.1 - 0.2 seconds (Vissing, *et al.*, 2008), <0.2 seconds (Edwin & Gordon, 2000), rapid muscle stretching when eccentric followed rapid concentric contractions (Ebben, 2002), the longer the amortization period, the less optimal the plyometric exercise (Koni, 2003), combining rapid and strong movements involving eccentric contractions, is immediately followed by explosive concentric contractions (De Villarrea, *et al.*, 2012 ).

The stretch shortening cycle is more influential with rapid movement and minimal ground contact (Komi., 2003). A decrease in contact time increases the movement strength and the stored elastic energy is not lost. The faster the clutch of eccentric action-the more concentric the effect of the exercise is the better. Clutch acts eccentric-concentric quickly, resulting in greater power and muscle deployment at the turn of the athlete running faster, jumping higher and changing direction very quickly. Based on the theory, the SCT training method should have a better effect in improving agility due to the shorter amortization time of 6.53 seconds / type of exercise than the 6.67 second PCT training method / exercise type (appendix 2).

While in PCT training, although longer contact time (amortization) has an advantage in the adaptation of biomechanical, physiological and neurological systems due to synchronization and coordination of vertical and horizontal jumping movements, sideways, forwards, backward, lateral, and twist (Verkhoshansky. 2009). Hartmann and Minow (2008) in Yasumitsu, *et al.*, (2012) explain that coordination is the ability to move the body skillfully, and as a prerequisite for sports performance. Coordination skills related to rhythm skills, balance skills, transformation skills, reaction skills, consolidation skills, orientation skills and know-how skills. Yasumitsu's research, *et al.* (2012) showed that 3 times weekly coordination training interventions in elementary school children aged 10-11 years, significantly improved the agility capability as measured by side step tests (35.69) for the experimental group and (32.87) for the control group ( $p < 0.005$ ). Participating in coordination training programs (such as PCT training) will improve the subject's ability to quickly change direction in response to conditions or orders. For example, when a subject performs a jumping twist movement on a particular obstacle followed by a twist bounce in different directions, they must make quick decisions and moves to remain stable. Also, possible improvements occur in the ability to identify different barrier positions and height of obstacles, ie, orientation and conversion skills, as shown by Hartmann and Senf (2008) in Yasumitsu, *et al.* (2012). It turns out that all improvements in the coordination will contribute to the increase in agility that is reflected in the side step test.

Avery *et al.* (2007), compared the effect of six weeks of plyometric combination training and resistance (PRT, n = 13) and weight training (RT, n = 14) in boy's fitness performance (12-15 years). The RT group performed static stretching exercises followed by weight training while the PRT group performed plyometric exercises followed by a weight training program. The training duration per session for both groups was 90 minutes. At the beginning and after the training all participants are tested on vertical jump, long jump, throwing medicine balls, 9.1 m sprint, agility and flexibility. The PRT group significantly ( $p < 0.05$ ) increased greater than the successive RTs for long jumps (10.8 cm vs. 2.2 cm), throwing medicine balls (39.1 cm vs. 17.7 cm) and agility (-0.23 sec vs - 0.02 sec).

Similarity of treatment with the test used also affects the results, the more similar treatment with the type of test used the higher the effect on the measurement results.

Illustration of similarity theory is shown by the more economical runners generally outperform the less economical runners in similar actions. Physiologically they consume less oxygen for an identical work rate. In other words, at certain running speeds, they do not have to work harder. In this case the PCT training method is more identical to the type of test used than the SCT training method so it gives better results. Besides being also reinforced by training specifications, training specifications refer to the methods and mechanisms responsible for physiological systems in responding to acute and / or chronic stress training.

It can be derived that the PCT training method is more effective in improving agility than the SCT training method. These findings simultaneously provide new information that shorten the time of contact (amortization) alone is still not enough to increase agility. Plyometric training involving a combination of vertical and horizontal jumping movement, sideways, forward, backward, to and from the lateral, twist, and shorten the amortization stage is indispensable for the development of agility quality.

## CONCLUSION

Based on the results of research and data analysis results that have been done, the conclusion is obtained: 1). PCT training methods have a significant effect on increasing agility; 2). SCT training methods have a significant effect on increasing agility; 3). There was a significant difference between PCT and SCT groups of agility, so it can be concluded that PCT group is better than SCT group against agility.

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