

Implementation of Sport Science Coaching: Improving Strength and Conditioning Performance of Tennis Junior Athletes

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Abstract—the purpose of this research is to examine the improvement of strength and conditioning of performance for junior-aged tennis athletes, especially strength, speed, and endurance, by using sport science and A T-test which was used to assess and measure the improved strength, speed and endurance of the experimental research method. The tests subjects for this research were 13 athletes of “Tennis Plus” in Bandung City, Indonesia, consisting of seven male and six female juniors. This research used 3 instrument tests: the first instrument test for strength was the “push up”, the second test for speed was a 20-metre sprint, and the third test for endurance was a “bleep” test. The results showed an increase in physical conditioning, comparing the pre-test and post-test instrument test scores, comparing t-count with t-table with significance level of 0.05. Initial test results and final tests for strength obtained a t-count = 3.09, for the speed tests they obtained a t-count = 2.05, and initial test result and final test for the bleep test and endurance obtained a t-count = 1.80, with t-table value = 1.71. The conclusion from the research showed that the application of a sport science-based training program increased the physical conditioning (strength, speed and endurance) of the junior tennis athletes.

Keywords—sport science, performance, strength conditioning, speed, endurance

I. INTRODUCTION

Tennis requires a variety of physical skills and complex motion skills, such as performing fast running, stopping immediately and moving again, jumping, reaching, twisting, doing wide strides without ever losing the balance of the body. Therefore tennis players desperately need the quality of strength, endurance, flexibility, speed, agility, and good motion coordination. This aspect is needed for athletes to move and react in order to explore every corner of the field during the game. Tennis games require Sports activities, having aims to achieve optimal performance in the competition. One way to support the achievement of an optimal athlete performance is to support the implementation of sports science. Sport science can be thought of as a scientific process used to guide the sport of sport with the ultimate aim of improving sporting performance [2]. In order to get some of them, it is necessary to use the findings of a well-designed research studies and to translate them into everyday practice. Understanding sports science by PTR

(2012) is, Sport science involves the practical application of sciences to human physical activity that is competitive sports and exercise. These sciences include exercise physiology, sports medicine, biomechanics, sports psychology, sports nutrition, kinesiology, motor learning and other fields. Many studies have examined sports, one of which is the study of coaching science research analysis published from 1970 to 2001. This study suggests that major research emphasis is mostly at the school level, not at the level of the athlete [7].

Faster movement and quick movements can only be done with an anaerobic energy system. These movements should be repeated throughout the game and the impact of the movement process will cause "fatigue", which will directly affect the work of the heart, lung, circulatory system, breathing, muscle work and joints of the body. Therefore, it is very important for tennis players to have an excellent physical condition. Through a well-programmed physical training process, these factors can be mastered. With a prime physical condition, it will certainly have a positive impact on mental fitness and psychic, which ultimately directly affects the appearance of playing techniques.

Sports activities have aims to achieve optimal performance during competitions. A way to support the achievement of an optimal athlete performance is to support the implementation of sports science. Sport science can be thought of as a scientific process used to guide sports with the ultimate aim of improving sporting performance. In order to get some of them, it is necessary to use the findings of well-designed research studies and to translate them into everyday practice [2]. Sports science by PTR (2012) can be understood by knowing that sport science involves the practical application of sciences to human physical activity, which is competitive sports and exercise. These sciences include exercise physiology, sports medicine, biomechanics, sports psychology, sports nutrition, kinesiology, motor learning and other fields. Many studies have examined sports, one of which is the study of coaching science research analysis published from 1970 to 2001. This study suggests that major research emphasis is mostly at the school level, not at the level of the athlete [3].

An application of sports science that can be done is the improvement of the physical condition of athletes in junior tennis athletes. The performance or appearance of a tennis athlete is dominated by a combination of strength, speed, and endurance. This is expressed by Tudor O. [8] who says that "most sport activities can be classified as having a predominant biomotor ability". With increased power and speed in the game of tennis, the characteristics of tennis games become larger, stronger and faster than ever. Therefore, strength training becomes an important component to compete. This is supported by research conducted by Racinals that muscle strength seems to affect speed and endurance [4]. The results say that the effect of strength on endurance can increase resistance training for long distance runners or cyclists by generating greater performance improvements than just being focused in durability training alone.

Many studies have conducted research related to the improvement of physical condition or physical condition relationship with skills in the sport. An example is carried out by Jeremy M. Sheppard, et al (2008) who examines the contribution of strength, explosive power, anthropometry to spike jump and counter movement vertical jump. Further research states that the importance of leg muscle strength, high vertical jump, speed and agility in determining the game time for division of a basketball student level [3]. Throughout the author's knowledge, no one has examined how the application of sports science in improving physical conditions (strength, speed and endurance) is related to tennis sports. Research examines the elite athletes in some sports, but not much research on the junior age. Therefore, the purpose of this study is to analyze whether there is an increase in physical condition (strength, speed and endurance) after being given exercise by using sports science to junior age tennis athletes.

II. RESEARCH METHOD

The research method used in this research is quasi experimental method using one pretest and posttest group design, as shown in the figure below:

TABLE I. DESAIN PENELITIAN ONE PRETEST AND POSTTEST GROUP DESIGN

Subject	Pre Test	Perlakuan	Post Test
R	O ₁	P	O ₂

This experimental method follows the procedure and meets the experimental requirements regarding the control group, the treatment or manipulation of activities, as well as the test results. This study examined and measured the changes that occurred by comparing the initial condition of the sample before being treated with the final condition of the sample after treatment was given. Hypothesis test proposed in this research is: there is improvement of physical condition (strength, speed and endurance) after given treatment. The treatment given in this study is the provision of strength training, speed and endurance. Giving strength training using rubber band, dumbbell, and medicine ball. For speed training, giving sprint exercise exercises with

ranges ranging from 10 m to 50 m. For endurance training, giving jog, straight bleep run and parley training interval. This treatment was administered within 6 weeks with a 4 x 1 week training meeting.

A. Subject

This research was conducted in tennis club plus West Java. The population in this study are tennis athletes in tennis club plus West Java who actively follow the training camp. The sample/subject of research used are boys and girls under the age of 15 years. The sample selection technique used purposive sampling technique. The subjects of the study were the athletes categorized in junior athletes in tennis west java.

B. Instrument Test

In this study, the tests were conducted with the aim of measuring the effectiveness of sport science in the improvement of physical condition (strength, speed and endurance) of tennis athletes. The test instrument used is a standardized test instrument and is in accordance with the criteria applied in measuring the physical condition (strength, speed and durability) in this study. Before doing the test, subjects are not expected to engage in activities that are too tiring, with the aim of obtaining maximum results as at the time of the test. The instrument used in this study to measure strength is: push up test and sit up test. While the instrument test utilized in measuring the speed is T - Run, and to measure durability using the bleep test. Before the athlete performs the 3 tests, the athlete warms up first. Heating is done, including general activities such as jogging and stretching for 10 minutes. When performing the test, there is need to prepare a variety of equipment such as: stopwatch, test kits and reach. In addition, it is also necessary to prepare blanks to fill out the test results and prepare the people who will test.

C. Data Analysis Technique

Data analysis technique used in this research is comparative test using parametric statistics. Comparison of two groups was tested using t-test. Hypothesis testing. Application of T-test is done by first calculating t using t calculation formula. The number is then confirmed with t-table on the degrees of freedom 0.05. If this is larger than t-table, then it can be described that the comparison group differs significantly. If the difference occurs due to the treatment, it can be concluded that the treatment has a significant effect because it causes differences in the groups that are compared.

III. THE RESULTS OF RESEARCH

Description of data from the results of research that aims at providing an overview of the distribution of data; distribution of the size of the location and of the frequency of the average, maximum value, minimum value, standard deviation, mode, median. The data generated based on the test results in this study are: strength, speed and durability. The description of data from the results of research and physical condition parameters for junior tennis athletes are presented in the table below.

TABLE II. DESCRIPTION THE RESULT OF RESEARCH

Analysis	Speed		Strength		Endurance	
	Pre test	Post test	Pre test	Post test	Pre test	Post test
Mean	5.07	3.53	18.38	28.31	8.61	9.84
Median	4.1	3.36	18	27	9.1	10.2
Modus	4.71	4.05	20	25	6.2	10.2
Standard Deviation	2.47	0.72	6.4	6.41	1.84	1.63
Min	3.27	2.55	12	22	6.2	7.5
Max	11.24	5.30	35	45	11.12	12.4

TABLE III. PHYSICAL PERFORMANCE GUIDELINES FOR TENNIS ATHLETE JUNIOR

Test	12 boy's	12 girl's	14 boy's	14 girl's
Sprint 20 m	3.57	3.58	3.36	3.4
Push Up	33	26	36	28
Bleep test	44.31	41.54	46.81	46.64

The results of hypothesis testing can be based on initial test results and final tests results which were conducted on variable strength, speed and durability. Based on preliminary test result and final test for strength, obtained t-count = 3.09 and t-table = 1.71 with a significance level of 0.05. Therefore t-count is larger than t-table. It can be concluded that there is an increase of strength after given strength training. Based on preliminary test result and final test for speed, obtained t-count = 2.05 and t-table = 1.71 with significance level of 0.05. Therefore t-count is larger than t-table. It can be concluded that there is an increase of speed after given speed training. Based on preliminary test result and final test for endurance obtained t-count = 1.80 and t-table = 1.71 with significance level of 0.05. Therefore t-count is larger than t-table. It can be concluded that there is a significant increase in endurance after being given endurance training.

IV. RESEARCH ANALYSIS

Research analyzes the application of sport science in an effort to increase strength, speed and endurance in tennis sports. The results showed that the application of sports science can increase strength, speed and durability and improve the performance of tennis athletes. Therefore, it is the responsibility of the strength conditioning coach to measure the level of physical condition in each athlete, by conducting an evaluation at the beginning and at the end of each training session. Early evaluation results are required for trainers to apply in training their athletes, by adjusting the physical condition of athletes and continuously monitoring their progress. Evaluation has two goals for athletes and coaches. For the athlete, evaluation is aimed at improving progress and evaluating the outcome of the exercise performed by the athlete, whether correct and in accordance with the instructor's instructions. For the coach, evaluation is aimed at evaluating the program to check if it is in accordance with the level of physical condition and characteristics of the child and sports that are cultivated.

Athlete testing should be tailored to the characteristics of the sport, so strength conditioning trainers need to understand the sport. The test chosen by the strength conditioning trainer must be in accordance with the sports parameters to obtain optimal results. "When selecting tests, the strength and conditioning professionally should analyze the energy system demands of the sport the athlete is being measured for" (Graham, 1994, p.9). According to the principle of specificity, conditioning programs must approximately be the mechanical and movement speed requirements of the sport. Test items should assess the physical characteristics it takes to succeed in a specific sport and the adaptations that occur in response to the prescribed conditioning program" (Ebben, 1998, p 42).

Based on the parameters in Table 2, the results shows that when a pretest is performed for the absent strength 100% of the athletes are included in the parameter. Whereas after being given strength training in the form of resistance, there is an increase of 46% (6 persons) of athletes who enter into these parameters. This suggests that there is an increase in strength in the early weeks of exercise for 5 - 8 weeks without having a noticeable change in muscle size and causes this increase in strength to be a contribution of neurological factors. There are two adaptations that occur in increasing strength, namely; intra muscular adaptation and inter muscular adaptation. Intra muscular adaptations includes the units of motor units (Cissik, 2001; 17 - 21), while Inter muscular adaptations refer to the upgraded coordination of muscle firing patterns. As exercise technique improves, muscles will work more efficiently and less energy is required to perform the exercise, therefore increasing resistance (Harris and Dudley, 2000; 19-20). To design a strength training program is to perform an athlete's need analysis, taking into account several things, including the major muscle groups used, the type of movement, the speed of movement and the place of frequent injury. To be able to maximize the results obtained, the program should be specific to the sport and in accordance with the characteristics of athletes.

For speed condition factor, the research result shows that when pretest is done for speed, only 1 (8%) athletes enters the parameter. Whereas after being given speed training in the form of sprint exercise, there was an increase of 62% (8 persons) of athletes entering the parameters. This factor is important to note because for tennis players it is important to have quick movement in the first step in every game start. The difference in the speed increase of 1/10 can change the defensive position into an attacking position. Specific speed exercises for tennis sports are different from specific exercises in other sports. In a sport of football that has such a wide field, the pace of the player's first step is not particularly noticed, as it can be hidden by a strong acceleration phase, (the first 40 meters) and in some situations (> 40 meters) where the maximum speed technique becomes the most important factor. While in tennis, due to the limited field size, the slow first step can't be hidden behind the acceleration or the maximum speed. Therefore, it is very important for the tennis player to focus and be consistent on every first step done in all directions.

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After the tennis player reacts to the stimulus (make contact with the ball), the athlete begins to make movements as fast and as strong as possible. It can be said that the factors that affect the speed of the initial step in tennis are: core strength, maximum strength, power and reaction time. Therefore, using a 100 meter sprint as an instrument test for speed in tennis should be avoided. This is as a result of the test not being specific to the tennis movement. It is more to measure how well the athlete can run at maximum speed and how small the athlete will decrease its speed towards the end of the 100 meter sprint. Thus, the right test instrument to test the speed in tennis is sprint, with a distance of not more than 20 meters. In the ten-meter tennis branch is the maximum distance a tennis player will run in a single blow on the pitch. In addition, the need to be noticed by strength conditioning trainers in training tennis athletes is part of the tennis acceleration which occurs within the first 25 meters. Thus, strength conditioning trainers need to design speed programs with spacing below 20 meters and involve explosive, linear, lateral and multi-direction movements. Related to the last condition factor in this research that is endurance, result of research indicate that when pretest for endurance is done, there are 4 (31%) athletes entering in the parameter. Whereas after being given endurance training in the form of jog, straight bleep run and parley training interval, there was an increase of 54% (7 persons) athletes entering the parameters. Tennis games require aerobic and anaerobic metabolism for sustainable energy supply throughout the game. Anaerobic energy is used to supply energy as long as the athlete plays to gain points by performing explosive and rapid movements, while aerobic energy is used to supply energy when players do break so that it can recover. Research conducted by Bergeron, M. F. et al (1991) and Kovacs (2006) stated as previously shown, that tennis is an aerobic sport due to the duration of the course. Based on this, to improve the ability of endurance recommended doing long distance running exercises for 30 minutes or more or doing interval training. This exercise is done 3 to 5 times per week.

V. CONCLUSIONS

The results showed that there was an increase in the appearance of physical condition (strength, speed and endurance) after being given treatment with the application of sport science in exercise. These three physical conditions are examined, because the third is the most basic physical condition and the three are interconnected to support the skills of tennis athletes maximally. The study also recommends that a strength conditioning coach should always conduct an evaluation before and after a training session to monitor progress. Performing the evaluation requires a test that is adapted to the characteristics of the sport and has parameters that fit the characteristics of the branch and athlete. The study also recommends strength conditioning trainers to know the types of exercises that fit the characteristics of the athlete's branch and age category.

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