

Chapter I

Introduction

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INTRODUCTION

Tennis is a most popular competitive sport attracting millions of players and fans throughout the world. A permanent programme of contests and events takes place during the whole year. Competitive tennis is played under the rules of the International Tennis Federation (ITF), and its competitions range from top professional events such as the grand slams and the olympics. The Association of Tennis Professionals (ATP) and the Women's Tennis Association (WTA) tours which includes more than 60 (WTA) to 80 (ATP) set of competitions, in around 40 countries, are organized in various categories, which express prize money and ranking scores. Thus there is much kind of opportunities for all levels of players to contest in any given week of the year. In addition, tennis is a usual recreational sport, which is enjoyed by people of all categories.

Tennis is characterized by quick starts and stops, repetitive overhead actions, and the involvement of various muscle groups during different strokes, which fluctuate by chance from certain periods of maximal or near maximal work to longer durations of moderate and low intensity activity. In addition, tennis is the one of the major sports to be played on a wide variety of surfaces, with various ball types, and competitions are played as the best of three or five sets. Modifications to the scoring system, duration of match, surface of playing, and type of tennis ball are known to influence the physical and physiological demands of tennis game. Accordingly, these variables might order the type of athlete who will be successful in the game of tennis. (Kovacs, 2006).

With varied specific sports training, resistance training and a successful programme needs to be designed with this balance and the goal in mind. A programme that is too general will not properly prepare the sport person, and a programme that is too specific (or attempts to be too specific) will also not properly prepare the player (an additionally runs the risk of overtraining certain movement patterns which increases the risk of injury). Researches on many training like plyometric, strength and power parameters, comparing its effect with some other training. However, efficacy of varied specific sports training on selected performance related fitness and skill performance variables of tennis players have not been attempted. So the researcher felt the need to do it, so that coaches and players can benefit from them. Though several studies have been conducted on tennis players and plyometric training, no study has been conducted to find out the combined influence of varied specific sports training, resistance training and plyometric training on tennis players. In order to find out the influence of varied packages of specific sports training, plyometric training and resistance training on tennis players, the investigator selected this study.

1.1 TRAINING

Training is a finest tool in the pedagogical world to enhance knowledge, skills and preparation of a person. Sport is a medium of education through practical activities, in which training has a significant and biggest role to perform excellence at par. The training is an art and science because a good trainer applies scientific principles and techniques (Sekhon et al., 2006).

The word training in its broad sense refers to any organized and systematic instructional process, which aims at enhancing man's ability with regard to physical,

psychological and intellectual aspects. In the field of sports, training is a process, which involves preparation of a sports person to attain highest level of sports performance (Uppal, A. 2013).

1.2 SPORTS TRAINING

The complex nature of sports training, in order to be effective and beneficial, requires knowledge and assistance from other sports science disciplines for example sports medicine, exercise and sports physiology, sports sociology, sports psychology, sports biomechanics, sports nutrition, sports biochemistry and so on. As the performance of a sportsperson improves, the extent of utilization of knowledge from these sports sciences also increases (Uppal, A. 2013).

The term 'Training' is widely being used in sports. Training aims at improving the fitness of persons. The same purpose of the training programme is to aid in the development of either health or better performance of an athlete. Training is not a recent discovery and in ancient times people were systematically trained for military and Olympic intervals. Today sportsmen prepare themselves for a goal through training. Training represents a long term endeavor.

In large groups in which absolute individualization of training programmes may be impractical, the coach should strive for individualization by homogeneously grouping athletes. Athletes rely on strength training to increase their ability in accordance with the demand of their sport. For the majority of the time, these athletes are given a strengthening programme that utilizes free weights and machines. However, there are times when an injury requires a therapy programme to assist in rebuilding strength. Then other exercises that include concentric or eccentric contractions, plyometric exercise are added. Although the

original intent of these exercises is for performance enhancement, they can also benefit athletes during the rehabilitation process. Most of these exercises are land based, but can be water based as well. Research has been conducted examining these exercise techniques as well as in developing new techniques to enhance the basic theories behind muscle development. There are various types of training methods we can use to obtain the required improvement in fitness. These methods include resistance training, circuit training, interval training, continuous training, plyometric training and flexibility training.

1.3 TYPES OF SPORTS TRAINING

1.3.1 Resistance Training

Resistance training is well established effective methods of exercise for developing muscular fitness. The main goals of resistance training as improving muscular strength and endurance and other benefits which involves increases in bone mass, reduction in blood pressure, increase muscle and connective tissue cross sectional area and decreased body fat.

Resistance training is any exercise that causes the muscles to contract against an external resistance with the expectation of increases in strength, tone, mass and endurance. The external resistance may be dumbbells, exercise tubing, own body weight as resistance and so on that causes the muscles to contract. This training works the muscles of the body and is highly beneficial when all kind of the ranges of motion are included. The training to improve strength, power and endurance of muscle performance is known as resistance training. Resistance training usually increases the size of muscle fibers. By increasing the strength of muscles, resistance training can also increase the power of muscles (Baechle, 1994).

1.3.2 Circuit Training

R.E. Morgan and G.T. Adamson introduced circuit training in 1953. This training programme involves almost every component of fitness and is very scientific and effective. In circuit training different specific exercises are performed in a sequence. In this programme selected exercises are to be performed at different stations. There can be five to ten stations in a single training programme with two to four sets. Athlete performs specific exercise in each station is also specified; degree of difficulty can be increased or decreased, depending upon the objective of training. Distance between each station also plays its role in adjusting the load. Circuit training can be formed to develop.

1.3.3 Interval Training

Woldemar Gerschler is the person who introduced interval training. The rest period during workout is the main part in this method. The load of work in this method is mainly decided by taking the period of rest in consideration. In this method the heart rate in intervals between the runs is controlling factor. After the workout the heart rate in the rest period when comes around 120 beats per minute, the athlete is allowed to restart the workout in some manner as was in previous. The duration of rest period must be of 80-90 seconds (if target is to get 120 beats per minute in resting heart rate). The duration here also decided the work load. Interval training in general is short breaks alternating with intensive short workout (Singh, A. B. 2012).

The concept of interval training is to train at the most efficient intensity of the sport for short periods and follow that with a rest period during which the lactic acid level subsides and repetitions of the same duration can be done. The amount of work that can be done by muscle tissue depends greatly on lactic acid level within that tissue.

If the level is kept down with intermittent periods of rest, more work at greater intensity can be done by the muscle. Without adequate rest periods between exercises, the lactic acid levels soar, thus paralyzing the muscle and preventing efficiency of performance. After a period of intense interval training, a player can exercise for longer and longer periods between until the intensity is great and the rest period is minimal. Exercise periods must also be at least equal intensity as the competition the athlete is training for or training effect will not be adequate for maximal performance. Anaerobic interval training, therefore, is recommended over aerobic training for the tennis player. High intensity sessions with adequate rest intervals are the key (Kriese, C. 1988).

1.3.4 Continuous Training

Dr.V.Aaken is the main head behind inventing this effective method for endurance development. The rest intervals in the training programme are missing. It is a continuous workout without any break. This method is generally used once in a week in advanced training programme. This method is also used for beginners with low intensity. There are three types continuous training method:

- (a) Slow continuous method
- (b) Fast continuous method
- (c) Slow fast (alternate) continuous method.

1.3.5 Plyometric Training

Plyometric exercises are key to the development of athletic power and are relevant to the majority of sports. Plyometrics may or may not be combined with weights exercises into a workout specifically designed to boost fast twitch muscle fiber output- this is known as 'power combining training'.

Plyometric muscular contraction release incredible amounts of force in a split second. This concentric following eccentric muscular contraction is crucial to speed and power in a highly sports specific way. This type of contraction happens every time a runner's foot hits the ground or when a rower drives hard into and out of stroke. As these examples indicate, plyometric exercises have a role to play in training for many other sports (Singh, A. B. 2012).

1.4 TRAINING FOR TENNIS PLAYERS

A tennis training programme should incorporate work on speed, agility, balance, reaction time, quickness, power and hand eye coordination drills can be used to develop these skills and it should be remembered that all drills should imitate actual match play. Exercises should be done to develop both the slow twitch and the fast twitch muscles.

It is essential for a tennis player to follow a good flexibility programme everyday to relax the body before competition, to guard against the possibility of injury during the match, and to improve any soreness from previous performances. Static stretching exercises should be done, but ballistic stretch exercise or any types of bouncing stretch exercises are not recommended. An anaerobic programme of training should be followed from three to a maximum of four days a week, and it is a good idea for a tennis player to include some aerobic training at least one day a week.

1.4.1 Muscular Endurance

The development of muscular endurance through physical training allows an athlete to participate at a higher intensity for longer periods of time, thereby, enhancing his performances later in the competition and helping him become a strong finisher in all events.

Muscular endurance developed through a good physical training programme enables the body to recover much faster after a strenuous match, allowing an athlete to participate day after day with the same level of excellence in all of his performances. Most athletes can compete very well early in tournament, but by the fourth or fifth day their bodies tend to break down under stress. A well coordinated athlete can go many days in a row and recover quickly each performance.

1.4.2 Anaerobic Endurance

Most of the energy used in playing tennis is anaerobic energy, and therefore it is important for an athlete to follow a good anaerobic endurance training schedule. Interval training or training with high intensity for short periods followed with rest periods can be used to train the anaerobic system. Seventy to ninety percent of the energy expended by a tennis player must be derived from his anaerobic (without oxygen) system. This means that the body in order to produce the energy needed to play tennis, uses the energy stored in the muscles. The chemical name of these energy sources are adenosine triphosphate (ATP) and phosphocreatine (PC), as well as glucose, which is broken down to lactic acid. Each point in tennis is an explosive type of exercise. Therefore, in order to gain maximum results, a training situation should imitate the playing of a point as closely as possible. The best physical training programme for tennis includes exercises with short explosive movements. Distance running, though, may be used for losing weight, for breaking the monotony of a training routine, or for general cardiovascular exercise.

1.4.3 Flexibility

Tennis is becoming more and more a strength related sport. Most of the top players are great athletes, and unless a player develops his athletic ability to its maximum potential, he cannot participate at the higher levels of the game.

A thorough, systematic flexibility programme can only aid the athlete. Good sense and judgment should be used, and a consistent programme should be followed. The idea behind stretching is to get the muscles to a state of readiness so that they can endure the heavy ballistic action that occurs during competition. It is important to recognize that stretching behind the normal movement capacity for a joint may be harmful in many ways to the athlete. Both over stretching and under stretching, therefore, should be avoided. With experience, the athlete will learn his own limitations in flexibility training.

Flexibility is defined as the range of motion of any joint in the body. Players today are discovering that the one most important and distinguishing quality top players have is flexibility strength. The players winning most tournaments today are those with much athletic ability and great flexibility strength. Therefore, the best fitness programme for a tennis player's physical development is one that combines both strength training and flexibility exercises.

1.4.4 Speed, Agility and Balance

Tennis is an extremely complex sport, in part because of the many different motor skills that are involved. Speed, agility, balance, reaction time, quickness, power and hand-eye coordination are all important. There is not enough time in practice to work on each of these

areas alone, so most coaches try to incorporate a training programme that encompasses many of them. Those of primary importance to tennis are speed, agility and balance.

Speed in athletics is defined as “the rate at which a person can propel his body, through space”. Every time a tennis player hits a tennis ball, his reaction time, quickness and power are important factors. Reaction time, or “the time between the stimulus and the initial response,” becomes a key element in any quick exchange of shots. Quickness is a term that refers to an athlete’s short spurts of speed. Power is defined as speed plus strength. Power has often categorized as the greatest individual determinant of athletic ability.

Agility is defined as “the physical ability which enables an individual to rapidly change positions and direction in precise manner”. In tennis, the need for this motor skill is quite obvious, because all stroke production is based on the ability to get from one part of the court to another, to set up, to keep on balance, and to change direction.

Speed agility refers to a player’s ability to move as quickly as possible while remaining in perfect balance so that a quick stop and change of direction can be made. Without the ability to get to the ball and then set up for a good stroke, good technical skills are useless. Lack of this combination of speed and agility can prevent a player from progressing to a new level in his game.

Professional players’ careers falter when they lose their speed and balance and cannot make effective shots. In fact, speed is always the first thing to go as a player ages or if he does not train. Again, though, it should be emphasized that speed alone is not lost, but speed, agility and balance, the three key ingredients to effective stroke production. Without them, it does not matter what the body is doing from the waist up.

Balance or the ability for a person to hold a stationary position, is also a very important ingredient needed for a tennis player's athletic achievement. Solid and well-placed shots cannot be made without this important motor skill. The researcher Bass states there is evidence to indicate that the ability to balance easily depends upon the functions of the mechanisms in the semicircular canals; the kinesthetic sensations in the muscles, tendons and joints; the visual perception while the body is in motion; and the ability to coordinate these three sources of stimuli. Balance is very much an inherited skill but it should be worked on as any other important motor skill in the tennis player's training routine.

All running and agility drills done in practice should emphasize good balance. Speed is of great help to a player with good balance as well. In all stroking work done in practice, the reminder, "head down, and feet on the ground," is critical to good development of the balance of good stroke production. Good balance allows a player's technical skills to remain effective long into his career. Good balance allows maximum leverage for stroke production for power and accuracy even if the athlete is not strong.

1.4.5 Consistency

Consistency is the ability to get the ball back and into the opponent's court time and time again. This should be a player's first goal as a new stroke is learned.

1.4.6 Placement

Placement is the ability to direct the ball from side to side. Being able to do this gives the player the control needed to run his opponent.

1.4.7 Depth

Depth is the ability to keep an opponent deep in the court. This prevents the opponent from being offensive and at the same time gives a player many options. Controlling depth may also mean the player's ability to hit short balls and to bring his opponent purposely to the net from time to time.

1.4.8 Spin

Spin is the ability to control the ball and give it spin. It also means being able to deliver a tennis ball that the opponent does not like to hit. Being able to hit a ball with top spin, under spin or side spin opens multiple dimensions of the game.

1.4.9 Power

Power is the ability to win points outright and to force an opponent into errors. It is exciting and enjoyable to have power, but it should be the last skill to be developed, although many make it their first. The elements that dictate power are speed of the racquet head and good timing (Kriese, C. 1988).

1.5 BENEFITS OF TENNIS TRAINING

Tennis is a sport with tremendous health benefits for individuals of all ages. It is also tremendously effective fitness training. Tennis game both challenges and builds a player's aerobic and anaerobic conditioning and also requires huge muscular strength and endurance. The tennis game developing positive personality characteristics like all the other games.

1.6 BIO MECHANICAL CONCEPTS OF TENNIS

1.6.1 Forehand and Backhand Groundstrokes

In recent past, the game tennis faced tremendous changes especially in strokes. Most of the muscles action in the lower body are almost similar for all the tennis strokes. The interplay between concentric and eccentric action allows the body to store and release the energy depend upon the phase of each tennis stroke. The strokes require trunk rotation, groundstrokes, serves and overhead strokes then that of attending volleys during the game. The muscles in the back of the shoulder and upper back act concentrically in the loading phase and eccentrically in the follow through action further the front of the shoulder and muscular of the chest contract eccentrically in the beginning at the time of backswing and then concentrically while executing forward swing. The backhand swing follows an opposite pattern. This swing patterns allows the players to hit the ball from open stance particularly while hitting two handed backhand groundstroke.

1.6.2 Forehand Groundstroke

During the backswing of the forehand groundstroke, the hip rotators, gluteals, quadriceps, soleus, and gastrocnemius contract eccentrically to load the lower legs and begin the hip rotation, also the concentric contraction of the shoulder and upper arm rotation in the transverse plane are performed by the teres minor, infraspinatus, latissimusdorsi, middle and posterior deltoid, followed by contractions of wrist extensor. In addition to this, the eccentric contraction of the shoulder and upper arm rotation in the transverse plane are performed by subscapularis, pectoralis major and anterior deltoid. At the time of follow-through, the upper arm movement decelerate through the eccentric contraction of wrist extensors, triceps, trapezius, serratus anterior, rhomboids, posterior

deltoid, teres minor and infraspinatus. Now a day the players are commonly using an open stance to play forehand, horizontal shoulder abduction and trunk rotation are the major cause to create the speed in forehand groundstroke.

1.6.3 One Handed Backhand Groundstroke

The wrist extensors play the vital role for the successful completion of backhand stores. In addition to this back of the shoulder flexibility of the upper back and strength are most important to play this stroke. At the time of backswing, the hip rotators, gluteals, quadriceps, soleus and gastrocnemius contract eccentrically to load the legs and begin the hip rotation. The wrist extensors, subscapularis, pectoralis major and anterior deltoid contract eccentrically to rotate the shoulder and upper arm through the transverse plane, as the serratus anterior, rhomboids, trepezius, teres minor, infraspinatus and posterior deltoid contract eccentrically. The acceleration phase of the upper arm is carried out by concentric contraction of trepezius, posterior deltoid, teres minor and infraspinatus particularly erector spinae and back extensors cause the trunk to rotate to execute the shot.

1.6.4 Two Handed Backhand Groundstroke

This stroke is very much beneficial at the early stage of a learner. Two handed backhand groundstrokes are being carried out by almost same muscle group which is required for one handed background. In this stroke the training should be given to the muscles of the torso and mid section especially the internal and external oblique. Further legs should be trained in order to provide a stable phase of support to transfer the forces from the ground to the racket and provide endurance for long duration matches. The flexors and extensors for the non-dominant arm wrist and the muscles involved in ulnar and radial deviation must be given appropriate training to execute two handed backhand groundstroke.

1.6.5 Service

A successful service is decided by pace, spin and placement. The combination of these three components bring out a best service. The execution of the service has three major phases, namely loading, acceleration and follow through. At the time of loading energy storage takes place. In the acceleration phase releases the energy through the end of the ball contact. The follow-through phase requires great eccentric strength to control the deceleration of the upper and lower body. In other words, the summation of forces from the ground up through the entire kinetic chain at the time of impact is known as the successful serve.

The knee flexing often defined as lower body loading. The gastrocnemius, soleus, quadriceps, gluteals and hip rotators contract eccentrically to load the legs to begin hip rotation. During the loading phase, a lateral flexion of the shoulder also increase potential energy storage. The energy will be released just before or during the impact of the ball. As a player loads after the serve, eccentric contraction of the gastrocnemius, soleus, quadriceps and gluteals decelerate the body. Eccentric contraction of the infraspinatus, teres minor, serratus anterior, trapezius, rhomboids and forearm supinator decelerate the upper arm. Some of these muscles helping the player to land safely by acting as shock absorber.

1.6.6 Volley

Volley shots are used especially when doubles matches are played. The players can acquire more number of points when a volley shot is attempted well angled. Greater flexion and extension at the hip, knee and ankles are more involved movement pattern when a volley is attempted. During the backswing of both the forehand and backhand volley hip rotators, gluteals, quadriceps, soleus and gastrocnemius contract eccentrically

to load the lower legs and begin the hip rotation. For the forehand volley, the concentric contractions of the upper arm rotation and shoulder in the transverse plane are performed by the teres minor, infraspinatus, latissimusdorsi, posterior and middle deltoid are followed by contraction of the wrist extensors.

The concentric contractions of the upper arm rotation and shoulder in the transverse plane are performed by the subscapularis, pectoralis major and anterior deltoid.

During the forward swing of the forehand and backhand volleys, the hip rotators, gluteals, quadriceps, soleus and gastrocnemius contract both eccentrically and concentrically to drive the lower body and hip rotation. For the backhand volley, the acceleration phase of the upper arm is performed through concentric contractions of the trapezius, posterior deltoid, teres minor, and infraspinatus.

During the follow through phase of the forehand volley, the upper arm decelerates through the concentric contractions of the wrist extensors, triceps, trapezius, serratus anterior, rhomboids, posterior deltoid, teres minor and infraspinatus.

1.7 TRAINING LOAD

Training load is the physiological and psychological demands put on the organism through motor stimuli (movements) resulting in development or maintenance of performance.

1.7.1 External Load

It is the work done by the sportsman. For example the distances covered by a swimmer.

1.7.2 Internal Load

It is the psycho physiological reaction of sportsman to external load. The degree of internal load is judged by pulse rate, lactic acid concentration in the blood and various bio chemical changes in the tissues. It can also be judged by various symptoms of fatigue.

1.8 PRINCIPLES OF LOAD

1. Principles of continuity and repetition
2. Principles of optimum load
3. Principles of load and recovery
4. Principles of specificity
5. Principles of progression

1.8.1 Principles of Continuity and Repetition

The load must be given several times to achieve the stable increase in performance capacity and the training should be continuous, otherwise achieved adaptation or performance improvement will be lost after some time.

1.8.2 Principles of Optimum Load

The load given is neither too low nor too much excessive, because no super compensation takes place or recovery process is slowed down respectively, therefore, for super compensation and optimum recovery the optimum load must be given.

1.8.3 Principles of Load and Recovery

Optimum load is essential to achieve good super compensation and the super compensation will take place only if enough time for recovery is given.

1.8.4 Principles of Specificity

Since specific type of load leads to a super compensation of a particular type of substance, when different performance factors need to be improved different type of load should be given.

1.8.5 Principles of Progression

The load should be increased from time to time for continuous improvement of performance. According to the need, the load should be given. For example, higher load should be given for the adaptation to a higher level (Sekhon et al., 2006).

1.9 OBJECTIVES OF THE STUDY

The objective of the study was

1. To find out the effect of varied packages of specific sports training programme for tennis players.
2. To find out the influence of each package of specific sports training separately for tennis players.
3. To identify the difference among the experimental groups after the prescribed training period.
4. To find out the most suitable training programme for better performance of male tennis players.

1.10 STATEMENT OF THE PROBLEM

The aim of the study was to predict the influence of varied specific sports training on selected performance related fitness and skill performance variables of tennis players.

1.11 DELIMITATIONS

The following factors were delimited to the present study.

1. The study was restricted to male tennis players.
2. Tennis players were selected from pro serve tennis academy Coimbatore - Tamil Nadu State in India.
3. The selected subjects' age group was from 11 to 14 years.
4. Along with skill training plyometric training and resistance training and the combination of both were given to the experimental groups.
5. Training was given for the period of 12 weeks, and a session for weekly thrice was framed for this study.

In this study the following independent and dependent variables were selected.

Independent Variables

Plyometric Training combined with Skill Training (PTST)

Resistance Training combined with Skill Training (RTST)

Plyometric and Resistance Training combined with Skill Training (PRTST)

Dependent Variables

Performance Related Fitness Variables

1. Right hand grip strength
2. Right leg hamstring flexibility
3. Left leg hamstring flexibility

4. Right shoulder flexibility-internal rotation
5. Right shoulder flexibility-external rotation
6. Trunk flexibility
7. Mobility
8. Abdominal muscular endurance
9. Speed
10. Leg explosive power

Skill Performance Variables

1. Service
2. Rally
3. Volley depth
4. Groundstroke depth
5. Groundstroke accuracy

1.12 LIMITATIONS

The following limitations were considered for the study.

1. The past experience of the subjects in the field of tennis that may influence the training and data collection were not considered.
2. Psychological factors, eating habits, rest period, life style were not taken into account.

3. The climatic conditions and meteorological factors during training and testing period were also not taken into consideration. Though the subjects were encouraged orally, no effort was made to differentiate the motivation levels during the period of test measurement and training.

1.13 HYPOTHESES

1. It was hypothesised that the plyometric training combined with skill training may probably enhance the selected performance related fitness and skill performance variables of male tennis players.
2. It was hypothesised that the resistance training combined with skill training may possibly develop the selected performance related fitness and skill performance variables of male tennis players.
3. It was hypothesised that the combination of plyometric and resistance training combined with skill training may significantly increase the performance related fitness and skill performance variables of male tennis players.
4. It was hypothesised that there would be remarkable difference among the experimental groups on the performance related fitness and skill performance variables which were selected for research of male tennis players due to the effect of varied packages of specific sports training.

1.14 SIGNIFICANCE OF THE STUDY

1. The main goal of research in the field of physical education is to assist coaches and physical education teachers to train their students based on innovative concepts to enhance their players' performance.

2. The unique aspect of this work is that include recommendations for the practical use of the research findings.
3. Varied specific sports training are one of the very important training regiments to improve performance in the game.
4. The study would add knowledge in the area of sports training related to tennis.

1.15 DEFINITION OF TERMS

1.15.1 Physical Fitness

Physical fitness is the ability to carry out daily task vigorously and alertly without undue fatigue and with ample energy to enjoy leisure time permits and to meet any unforeseen emergencies (Clarke, 1987).

1.15.2 Muscular Strength

Muscular strength is defined as the ability of a group of muscles to develop maximal contractile force against a resistance in a single contraction (Vivian, 2010).

1.15.3 Muscular Endurance

Muscular endurance is the ability of a muscle group to exert submaximal force for extended periods (Vivian, 2010).

1.15.4 Explosive Power

Explosive power is the ability to overcome heavy resistances with high speed (Singh, 1991).

1.15.5 Flexibility

Flexibility is the range of movement in a joint or sequence of joints (Clarke, 1987).

1.15.6 Speed

Rapidity with which a movement or successive movements of the same kind may be performed (Clarke, 1987).

1.15.7 Grip Strength

Grip strength measures the strength of the finger flexors and forearm muscles. The right grip is tested first and then the left grip is tested (Paul Roetert, 1998).

1.15.8 Hamstring Flexibility

Hamstring flexibility measures the amount of stretch in the muscle at the back of the thigh (Paul Roetert, 1998).