EFFECT OF EASY FIVE TRAINING PROGRAMME ON TECHNICAL AND TACTICAL PERFORMANCE IN MALAYSIAN JUNIOR TENNIS PLAYERS

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EFFECT OF EASY FIVE TRAINING PROGRAMME ON TECHNICAL AND TACTICAL PERFORMANCE IN MALAYSIAN JUNIOR TENNIS PLAYERS.

ABSTRACT

An athlete‟s success or optimal performance during competition is the ultimate goal of any coaches. This study is to explore the effects of Easy Five training programme on technical and tactical performance of Malaysian male junior tennis players. The motive of this study is to seek out a realistic and feasible solution in order to enhance the performance of Malaysian junior tennis players. It involved a discussion of the theoretical issues raised especially on the effectiveness of Easy Five training programme as well as its relation with previous research. A total of thirty junior tennis players (n=30) were selected in this study and were divided into Experimental and Control groups with each group consists of fifteen participants (n=15). All participants were tested on their performance variables namely the Groundstroke Depth, Groundstroke Accuracy, Volley Depth, Serve, Agility and International Tennis Number (ITN) total score. The Experimental group was engaged into the Easy Five training programme and Control group went through tennis match play for 8 weeks. These methods correlate with the objectives of this study which focuses on the technical and tactical performance of all the participants and investigating the effects of an Easy Five on the performance of the Malaysia junior tennis players. A mixed between-within subject analysis known as split-plot ANOVA (SPANOVA) was used to test the research questions. The pairwise comparison within group test of pre-test and post-test results indicated that there was a statistical significant difference in the performance of Experimental group in Groundstroke Depth ($p = 0.001$), Groundstroke Accuracy ($p = 0.001$), Volley Depth ($p = 0.001$), Serve ($p = 0.01$), Agility ($p = 0.001$) and International Tennis Number (ITN) total score ($p = 0.001$). The results proved that participants from Experimental group showed an improvement in all of the performance variables and

also validate the positive effect of Easy Five training programme. Control group showed a slight improvement in agility performance with (p = 0.01). Results from statistical analysis also indicated that there are statistical significant difference between the two groups after 8 weeks treatment in Groundstroke Depth ($F_{1,28}$ = 12.59; p = 0.01), Groundstroke Accuracy ($F_{1,28}$ = 15.24; p = 0.01), Volley Depth ($F_{1,28}$ = 29.55; p = 0.001) and ITN total score ($F_{1,28}$ = 61.33; p = 0.001) but indicated no significant difference in agility ($F_{1,28}$ = 1.53; p = 0.23) and serve ($F_{1,28}$ = 1.14; p = 0.29) performance which dictate the optimistic effect of intervention training programme engaged in this study. The findings revealed that the Easy Five which reflects the game situations training approach is a viable method in formulating a training programme as it shows positive effects on the performance and provides significant recommendations to coaches and players about designing an effective training programme.

Keywords: performance, training, technical, tactical, tennis.

KESAN PROGRAM LATIHAN EASY FIVE KE ATAS PRESTASI TEKNIKAL DAN TAKTIKAL PEMAIN-PEMAIN TENIS REMAJA MALAYSIA

ABSTRAK

Kejayaan seseorang atlet atau prestasi yang optimum dalam sesuatu pertandingan merupakan matlamat utama setiap jurulatih. Kajian ini bertujuan untuk mengkaji kesan kaedah latihan Easy Five terhadap prestasi teknikal dan taktikal di kalangan pemain-pemain tenis remaja lelaki Malaysia. Motif kajian ini adalah untuk mencari penyelesaian yang realistik dalam usaha untuk meningkatkan prestasi pemain. Kajian ini juga melibatkan perbincangan mengenai isu-isu teori yang dibangkitkan terutama faktor keberkesanan kaedah latihan Easy Five serta hubungkait dengan beberapa kajian yang terdahulu. Sejumlah tiga puluh (n=30) pemain tenis remaja telah dipilih dalam kajian ini dan dibahagikan kepada kumpulan Eksperimen dan Kawalan dengan setiap kumpulan mempunyai lima belas peserta (n=15). Setiap peserta diuji dalam setiap pembolehubah prestasi yang berbeza iaitu Groundstroke Depth, Groundstroke Accuracy, Volley Depth, Serve, Kelincahan dan jumlah mata International Tennis Number (ITN). Kumpulan Eksperimen menjalani kaedah latihan Easy Five manakala Kumpulan Kawalan menjalani perlawanan tenis selama 8 minggu. Kaedah ini mempunyai kaitan dengan objektif kajian di mana tumpuan adalah terhadap kesan programme intervensi ke atas prestasi teknikal dan taktikal serta menyelidik kesan kaedah latihan Easy Five terhadap prestasi pemain-pemain tenis remaja Malaysia. Split-plot ANOVA (SPANOVA) digunakan untuk menguji soalan-soalan kajian. Keputusan analisa pra-ujian dan pasca-ujian membuktikan bahawa Kumpulan Eksperimental menunjukkan perbezaan ketara peningkatan prestasi dalam Groundstroke Depth ($p = 0.001$), Groundstroke Accuracy ($p = 0.001$), Volley Depth ($p = 0.001$), Serve ($p = 0.01$), Kelincahan ($p = 0.001$) dan jumlah mata International Tennis Number (ITN) ($p = 0.001$). Keputusan membuktikan peserta-peserta dalam Kumpulan Eksperimental

menunjukkan peningkatan yang ketara dalam semua pembolehubah prestasi dan mengesahkan kesan positif kaedah latihan Easy Five. Analisa statistik menunjukkan Kumpulan Kawalan hanya menunjukkan sedikit perbezaan dalam prestasi kelincahan dengan (p = 0.01). Keputusan analisa statistik antara Kumpulan Eksperimental dan Kumpulan Kawalan menunjukkan perbezaan ketara antara kedua-dua kumpulan selepas 8 minggu latihan dalam Groundstroke Depth ($F_{1,28}$ = 12.59; p = 0.01), Groundstroke Accuracy ($F_{1,28}$ = 15.24; p = 0.01), Volley Depth ($F_{1,28}$ = 29.55; p = 0.001) dan jumlah mata ITN ($F_{1,28}$ = 61.33; p = 0.001) tetapi menunjukkan tiada perbezaan ketara dalam prestasi kelincahan ($F_{1,28}$ = 1.53; p = 0.23) dan servis ($F_{1,28}$ = 1.14; p = 0.29) di mana ini menetapkan kesan optimistik programme latihan intervensi yang digunapakai dalam kajian ini. Kumpulan eksperimen menunjukkan peningkatan keputusan yang lebih tinggi dan dengan itu mengesahkan kesan optimistik programme latihan intervensi yang direka dalam kajian ini. Dapatan kajian telah mendedahkan bahawa Easy Five yang menggambarkan pendekatan latihan keadaan perlawanan adalah kaedah yang berdaya maju dalam merumuskan programme latihan kerana ianya telah menunjukkan kesan positif ke atas prestasi dan memberikan cadangan yang penting kepada para jurulatih serta pemain mengenai perancangan programme latihan yang berkesan.

Katakunci: prestasi, latihan, teknikal, taktikal, tenis.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

It is an ultimate goal of any coach to have their athletes to achieve success or to reach optimal performance during a competition. For effective practices and success, coaches need to understand the complex processes in developing athletic performance. Amongst others, systematic training and well-planned programmes may be significant in youth development programmes (Williams & Reilly, 2000). Improving or enhancing the performance of the athletes as much as possible is always the aspiration of any coach. Effective training is about providing not only quantity but also quality programmes. There are many essential features in achieving excellence in athletes‟ performance such as the drive to succeed, the ambition to push beyond limits and the desire to be the best in the sports.

Athletes also must be able to demonstrate an excellent level of technical and tactical abilities and to have a longer stability physically and psychologically. A simple subjective view or perception on how well the athletes perform can no longer be applied as foundation of training and competition. The need to record, analyze and evaluate information on important areas such as physical, psychological, technical and tactical skills has become fundamental to the elite performance. The information on several characteristics of sports performance is the foundation for providing feedback on how the athletes are performing (Carling, Reilly & Williams, 2009). This feedback will lead to the development of up to date coaching interventions or methods centered on evidence-based training programmes. If athletes are to attain best performance, information from continuous assessment of training and competitions must be available in order to assist in the evaluation of athletes‟ performance and progress. Therefore, it is

important for coaches to possess a solid framework of sport science support system which is designed to help foster the skills of athletes and to enhance their performance.

Tennis is a distinctive sport which demands an integration of multiple factors or components. Over the years, tennis has turned to be one of the most popular sports being played all over the world and many high competitive tournaments are being organized. As a high performance sport, tennis continues to develop and grow, accompanied by rapid transformation of the game. There is also an increasing need to develop performance qualities in which elite players can be trained to achieve their goal in international excellence. In order to be successful, a tennis player must have a high level of commitment and be willing to persist in a rigorous training programme.

Tennis associations or governing bodies are responsible for the development and administration of the sports and must embark into scientific researches on a continuous basis to explore the latest development of technology and effective approaches in identifying and honing the potential of young tennis players. It must be one of the main goals of any national tennis association to promote the sport and to develop young juniors for the sport of tennis at early stage of age. In order to achieve this, a systematically organized development programme is important for any tennis nation wishing to develop future professional and successful tennis players (Seibold, 2011). In recent years, sport-science based tennis projects have seen researchers trying to identify and determine the specific features that tennis requires for young children to become top players (Crespo & McInerney, 2006).

Tennis has evolved rapidly over the years from a sport dominated by technical and tactical skills to a competitive sport dominated by physical prowess as well as mental

strength and tactical abilities. As such, many sports scientists have been researching methods and new approaches or tools to help to train the tennis players in the lab and on the court. This is to facilitate the tennis players to reach their full potential during competitions as well as in their playing career. The need for performance analysis has been a crucial method in which coaches and players can observe and analyse past performances with the hope that it will improve future performances (Hughes & Franks, 2008). O'Donoghue (2010) agreed by explaining that performance analysis is essential to enable coaches and players to assess the requirements of individuals and teams to produce a better understanding of how future performances can be improved. There has been little research regarding how consistent a tennis player's performance within the field of performance analysis. Previous performance analysis research within tennis has been focusing on the tactics and strategies that elite athletes use when competing at tennis tournaments. Analyzing strengths and weaknesses of an athlete is a valuable process that can help in the planning of training regimes and the identification of long-term goals as a focus for self-improvement.

1.2 Sports Performance

Sports performance requires an athlete to integrate many factors which, some are trainable such as physical and psychological skills where else some are teachable such as tactics and others are out of the control of the athletes and coaches such as genetics and age (Smith, 2003). According to Sanz (2011), sport performance is determined by the optimal relationship between the physical, tactical, technical, and also the psychological components of the player. Optimal performance requires an integration of all these components. Each of these components has its own development paths and methods. Developing the components in an integrated way is known as the holistic approach and each component is interconnected. According to Bangsbo et al. (2006),

performance of an athlete in top sports depends on the athlete‟s technical, tactical, physiological and psychological or social characteristics. Improvement in performance, particularly at the elite level, largely depends on applying scientific knowledge to increase the quality of training programmes. Therefore, it is always recommended that tennis players train in a specific manner to improve on their tennis-specific performance. Improving tennis performance is the main goal of every coach and player; as such effective planning and training programmes will definitely help to optimize the players‟ performance. All the training factors which include technical and tactical training must be performed at the highest parameters in order to achieve the desired sports excellence.

The development of performance in competitions is achieved through an organized and systematic training process that is planned to improve automation of skills and enhance skills or abilities of athletes. Training is the total process of preparation of athletes, through various means and forms for better performance. Training also promotes self-confidence and tolerance for higher training levels and competitions. In order to improve skills and performance during competitions, athletes must prepare themselves through a training process where the fundamental objective is to improve body function and optimize the performance. The training process involves repetition of exercises designed to induce automation in the execution of a motor skill and develop structural and metabolic functions that lead to increase the physical performance (Viru, 1995). Effectiveness of physical training involves the application of the training load through the variables such as intensity, duration and frequency. Sport activities are a combination of physical prowess executed in a coordinated and efficient manner with the development of sport-specific characteristics. Hence, training for peak sporting performance includes training for physical development (general and sport-specific

factors), technical and tactical training (Bompa, 1999). During the competition time, optimal performance requires a good health and integration of not only the physical elements but also the psychological, technical and tactical components.

Tennis is a sport that requires a mixture of complex skills and physical attributes (Kovacs, 2007). Training the tennis players requires the successful integration of physical, psychological, technical and tactical attributes. These attributes will help the players in his or her game. Technical development will improve the players in various strokes such as forehand, backhand, serve and volleys. On the other hand, tactical development will assist on the usage of different techniques while mental preparation will provide stability of the players in critical situations. Physical prowess will help the players to execute skills at an optimum level. According to MacCurdy (2006), tennis is an open loop sports which requires constant decision making, response organization, spatial awareness as well as wide range of physical, psychological, technical and tactical abilities. Tennis player cannot be successful if he or she only excels in one area such as technical aspect but lack in other areas such as physical, psychological and tactical aspects. Since the effects of training on the body are very specific and not easily transferred from one activity to another, the exercises used in training should reflect the demands and characteristics of tennis play.

Tennis is classified as an open-skill sport by motor-learning researchers where players constantly make tactical decisions related to specific game situations (Elderton, 2010). Based on the knowledge of their own strengths and weaknesses, and those of their opponents, players apply different strategies and tactical concepts to maximize their chances of winning a match (O' Donoghue & Ingram, 2001). In order to play tennis at a competitive level, certain standards need to be achieved in all major

components of performance such as physical, psychological, technical and tactical areas of skills or abilities. Kovacs (2007) reports that an elite tennis player should be trained in four important facets: the physical, psychological, technical and tactical. Optimal performance can only be achieved through a meticulously planned and well controlled training system based on a scientific knowledge and proven methods of training fundamentals.

1.2.1 Physical Demands of Tennis

Tennis has evolved from a sport in which skill was the primary prerequisite for successful performance into a sport that also requires complex interaction of several physical components and metabolic pathways (Fernandez-Fernandez, Sanz-Rivas & Mendez-Villanueva, 2009; Fernandez-Fernandez et al., 2014). The nature of the game has evolved over the years, from a sport which stresses technique and skill, to one that demands a diverse range of physical attributes (McCarthy, 1997). Tennis is characterized by quick starts and stops, repetitive overhead motions, and the involvement of several muscle groups during the different strokes, which fluctuate randomly from brief periods of maximal or near maximal work to longer periods of moderate and low intensity activity (Perry, Wang & Feldman, 2004). The players may have good techniques and game plan, but if they do not have good physical fitness, they will not be able to perform at their best. This is because adverse physical state will impose constraints on the player‟s performance. The competitive nature of the sport requires a great physical demand on the body. Therefore, aspiring tennis players must have the capabilities to persist physical stress exerted on them during prolonged and intense matches.

Agility skill and agility training play important roles in enhancing sport performance (Paul et al., 2011). Agility has been simply defined as the ability to quickly and accurately change direction (Young, James & Montgomery, 2002). Young, James and Montgomery (2002) outlined a comprehensive definition of agility as it related to running sports by addressing the multi-faceted influences involved in agility performance. They outlined that there are two main components of agility which are change of direction speed and perceptual and decision-making factors. Agility has relationships with trainable physical qualities such as strength, power and technique, as well as cognitive components such as visual scanning techniques, visual scanning speed and anticipation. Tennis is a unique sport that involves various movements to complete many quick starts and stops such as acceleration and deceleration, repetitive overhead motions, and many different types of strokes (McKinley & Sato, 2014). During an average match a tennis player would complete around four directional changes per point, (Fernandez et al., 2006). These directional changes can be further broken down into three categories as tennis players move 1) forward forty-seven percent of the time, 2) sideways forty-eight percent of the time, and 3) backwards five percent of the time, (Parson & Jones, 1998). These findings indicate that agility is a very important component for tennis players to develop to improve their performance.

Few studies have highlighted the importance of agility to tennis performance. Bornemann, Gabler and Reetz (1988) claimed that most of tennis strokes are influenced by footwork and speed around the court. Roetert et al. (1992) conducted a study to examine the contribution of physical abilities and tennis skills to tennis performance where the United States Tennis Association (USTA) rankings were employed as a measure of tennis performance. They found that only agility measure was shown to be

related to sectional rankings and suggested that agility may be the first physical ability to influence the competitive level of young tennis players.

1.2.2 Technical Skill

At the initial stage of development, technical aspect plays an important role in the success of the tennis players. The technical aspect in tennis, comprise of basic skills such as forehand, backhand, volley, overhead and serve, footwork and application of both footwork and basic skills in tennis. The technical aspect is like the heart of tennis. If the player does not master the technical aspects, it is difficult for him or her to become a good player. Capitalizing on the opportunities to master in technical skills is essential to the development of tennis player's game. In this sport, every tennis athlete develops a unique style of game play that empowers his or her performance. By mastering the tennis technical skills, it builds a strong and solid tennis foundation.

According to MacCurdy (2006), at the age of 7 to 10 years old, the child should have an average level of mastery in ball and racket handling. At about 12 years old, the young player should master all the basic shots: serve, forehand, backhand, volleys and overhead. After that, the player should be able to maintain basic consistency and add power in his or her game along with his or her true weapon development such as big serve and forehand. At this stage, the coach plays an important role in developing the right techniques in a player. If the coach teaches the children the wrong concept of techniques in tennis at the early stage, it may affect the development of his or her game in the future. Good technique will enhance the ability of players to perform effective tactics, minimize injuries, preserve energy and increase impact of shots.

Roetert et al. (1992) found that stroke ability influences rankings more than physical ability and the findings concurred with those of Birrer et al. (1986), whose 5 year study of 531 junior players displayed strong positive correlations between tennis strokes and tournament play. Birrer et al. (1986) also concluded that the ability to perform quality tennis strokes and technical skills were more relevant to successful play. One of the success factors in winning a tennis match is to keep the groundstrokes deep with consistency and optimum power (Kushwah, 2014). Tennis groundstrokes are the fundamental shots in tennis. The forehand and backhand groundstrokes are the two forms of shots used in the baseline rallies (Kushwah, 2014). Serve and return of serve are regarded as the two most important shots in tennis (Gillet et al., 2009; Unierzyski & Wieczorek, 2004). Another important stroke is volley which is an offensive technical skill. Volley is usually performed under the time stress due to the reducing distance between the players (Chao et al., 2008).

1.2.3 Tactical Skill

Apart from the physical, psychological and technical aspects as discussed above, tactical aspect also plays an important role in the success of a tennis player. Accordingly, a „tactic" refers to "the practical application of the strategy during the match" (Crespo & Reid, 2009). Strategy refers to organizing the play or competition of the athlete (Bompa 1999). The tactical aspect plays crucial part in determining whether he or she can win the match or not. In tennis, there are four types of game styles that can be used by players such as net rusher, aggressive baseliner, counter puncher and all round players (ITF, 1998; USTA, 1996). All these game styles would suit to the player based on his or her techniques, mental approach and physical conditioning. The tactical skills normally will take some time, exposures and experience to master it out as it is considered one of the most critical aspects of a player's development. A coach must

have a systematic way of developing tactical skills in a player. Tennis players must be trained in good decision making to effectively secure points and play smart. The players should be intelligent enough to construct a game plan that capitalizes their strengths and manipulates opponents‟ weaknesses.

One key process in training that has to be conducted by coaches in training their athletes is qualitative analysis in the form of diagnosis and evaluation. Knudson and Morrison (2002); as cited by Crespo and Reid (2009) demonstrated that the model of qualitative analysis puts evaluation as an interceding component in between observation of a task performance and intervention implementation. Such process of evaluation as showed in Figure 1.1 enables coaches to comprehensively identify their athletes‟ current performance, determine accurate intervention methods or training and also realistically set milestones for the athletes to achieve in their long run.

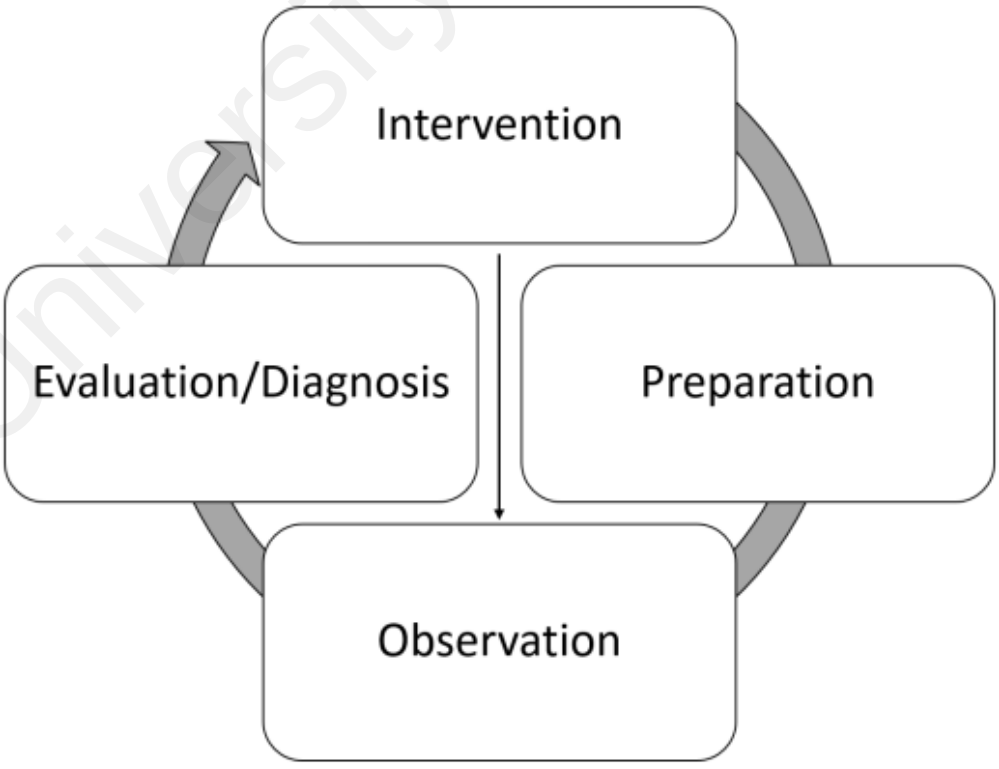

Figure 1.1: The four task model for qualitative analysis (Knudson & Morrison, 2002)

The qualitative analysis as showed in Figure 1 is proposed to aid coaches strengthen their athlete‟s game and draws the coaches‟ as well as athletes‟ attention on the more crucial and appropriate technical and tactical factors in the evaluation of performance (Knudson & Morrison, 2002). In a tactical evaluation, some determining variables that are noteworthy for the strategy-making process are the players‟ consistency and accuracy in their services and their groundstrokes. Chalakov (2014) stated that sport‟s training for 12 year old players are based on the indicators for consistency and accuracy. These are the two tactical factors that contribute significantly to tennis players‟ performance in competition.

1.2.3.1 Consistency in Tennis

Consistency in tennis refers to the ability of a player to get the ball back more times than an opponent using optimum pace and control (Rive & Williams, 2012). Consistency is one of the tactical components as stated in the United States Professional Tennis Association (USPTA) Player Development Programme (USPTA, 2008). Studies have been conducted since 1986 attempting to highlight performance factors that would influence a winning gameplay among young players in tournaments (Birrer, Levine, Gallipi & Tischler, 1986; Roetert, Garret, Brown & Camaione, 1992). Findings from such studies pointed out that instead of physical ability, which is the fundamental ability that requires development in performance conditioning, tactical and technical abilities show more representative data as to why a player is able to come out on top in matches for that age group. This situation also applies to all levels of tennis gameplay; as being able to return the ball into the opponent‟s court repeatedly keeps one from losing the point in play.

1.2.3.2 Accuracy in Tennis

Accuracy in tennis refers to the ability to hit the tennis ball to a specific target on the tennis court. According to Strecker et al. (2007), one of the criteria for performance analysis in tennis is accuracy which is the ability to execute a shot that lands at specific locations in the tennis courts. Indeed, the ability to return the ball back into the opponent‟s court over and over again can save a player from losing the point. However, fatigue induced following the effort of getting into contact range with the ball would be the death of the player‟s survivability in the point. Few studies have shown how players‟ performance of both amateur and elite levels‟ accuracy fluctuate and deteriorate as fatigue develops in the body (Davey, Thorpe & Williams, 2002; Lyons, Al Nakeeb, Hankey & Nevill, 2013). Thus, another strategy to prevent losing the point would mean that the player goes for winning the point, or making his returns equally difficult for the opponent to return the shot. From the defensive situation, the ability to place the ball in and beyond one‟s reach requires a high demand of decision making and stroke ability from the player to land the ball from different points in into specific angles accurately. This may be the reasoning behind Holm and Klavora (1987) insisting that a player‟s ability to perform powerful, accurate and consistent return shots as a main characteristic of distinguished professional players, thus suggesting that these two aspects should be monitored, and evaluated for improvement and further development of a player.

1.3 International Tennis Number (ITN)

Standardized testing is commonly used to provide a useful supplement to subjective coaching appraisals in an attempt to assess strengths and weaknesses of a given player. Therefore, research has been conducted with athletes of various backgrounds in order to identify the most influencing factors of significance in successful tournament play

(Birrer et al., 1986; Girard & Millet, 2009; Kraemer et al., 1995; Roetert et al., 1992; Roetert et al., 1996). To date, several tennis-specific test procedures have been used to determine the performance of athletes with acceptable accuracy under standardized conditions. In this regard, identifying the determinants of performance is crucial for the profiling and predicting of athletes‟ performance (Reilly, Morris, & Whyte, 2009).

The International Tennis Number (ITN) is an international tennis rating that represents a player‟s general level of play. The ITN On-Court Assessment test was created by International Tennis Federation in 2003 and it consists of five different sections (Groundstroke Depth, Volley Depth, Groundstroke Accuracy, Serve and Agility). It is an easy and effective tool to assess performance levels of especially creative, beginner and middle level tennis players. Players are rated from ITN 1 to ITN 10. ITN 1 represents a high level player (holding an ATP/WTA ranking or of an equivalent playing standard) and ITN 10 is a player that is only beginning to play competitively (can serve and return) on a full court using a normal ITF approved ball. In order to facilitate the rating of players, the ITF have developed a description of standards and an objective „On-Court Assessment‟ both of which can be used to rate players in the absence of competition results (The International Tennis Federation, 2004). The ITN Description of Standards avoids rating players purely on the technical assessment of individual shots (ITF International tennis ratings taskforce, 2003). Instead it uses the following as its basis:

- the general characteristics of various playing levels;
- the five-game / tactical situations of tennis (e.g. serving, returning, both at baseline, approaching, passing); and
- the game-style of the player.

Whilst the ITF recognizes some of the limitations of any non-competition based assessment in tennis (for example, the static feeding, only assessing strokes in a closed situation, only certain strokes being assessed) many researchers believe that the ITN On-Court Assessment is a powerful tool that can be used in conjunction with the ITN rating system and to complement competitions, particularly for the recreational players. Not only can the assessment be used as an objective method of initially rating those players that have no history of competition results but it can also be used as a powerful promotional tool at events and as a means for players at different levels to measure their improvements in certain aspects related to tennis play (The International Tennis Federation, 2004).

1.4 The Easy Five

Major shift in teaching methodology has been the catalyst of structuring the teaching and coaching process with the idea of adapting it to the match situation and thus emphasizing the role of strategy and tactics in the initial stages of the game which is the tactical approach coaching (Unierzyski & Crespo, 2007). In recent years, tennis teaching and coaching, tennis experts have advocated a shift from skill-based approaches which focus on specific aspects of the sport, to a more game-based approach which are closely related to the sport as a playing situation (Papageorgaki, 2014). Research by Turner (2003) confirmed that because of tactical or game based approach tennis players demonstrate better game performance.

The games approach emphasizes the use of games and mini games to provide athletes with situations that are as close to a real match as possible (Launder, 2001). Research conducted by McPerson (1991), McPerson and French (1991) and Turner (2003) confirmed that because of tactical and game based approach tennis players

demonstrate better game performance and have higher level of specific knowledge than players coached according to traditional approach. Recent studies into tennis coaching support that a game-based approach underlines the necessity of implicit learning (Barrell, 2013; Buszard, Reid, Farrow & Masters, 2013; Iserbyt, Madou, Vergauwen & Behets, 2011; Pankhurst, 2013; Zmajic, 2013). Through reflecting on this implicit learning function while teaching tennis, it could be claimed that the tennis coach is expected to limit direct instructions and create a learning environment in which children can experiment in playing tennis (Barrell, 2013).

The tactics employed by a player can be gleaned from five game situations: the serve, the serve-return, both players on baseline, approaching or at the net, and passing (Crespo & Miley, 1998; Dent, 1994; Van Der Meer, 1996). In the game of tennis, the coaching methodology is based on assumption that at any given moment the player must be in one of the five game situations and will perform certain tactics (Tennant, 2004). Therefore, the goal of coaching process in all modern methods is to teach the players how to deal in these five game situations (Unierzyski & Crespo, 2007). Crespo (2000) has named the training drills to work on the five game situations as "The Easy Five".

1.5 Tennis Match Play

Tennis matches are contested between either two competitors in singles match or between two pairs of competitors in doubles match. Both competitors compete in a series of points which then produce a game, a competitor must win 6 games to win the set and it can be best of 3 sets or best of 5 sets to win a match. Hornery, Farrow, Mujika and Young (2007) explained that tennis matches can last for hours and can affect ones performance. Tennis match play is characterized by intermittent exercise, alternating

shots between 4 to 10 seconds, bouts of high intensity and short recovery bouts between 10 to 20 seconds, interrupted by several periods of longer duration between 60 to 90 seconds (Pluim & Safran, 2004). These recovery periods are controlled by the rules of International Tennis Federation (ITF) which is the world governing body of tennis. These rest times are 20 seconds between points, 90 seconds between changeovers and 120 seconds between sets (ITF, 2002).

Some studies indicated that time spent on competition and match play in tennis is a basic factor in expertise development and that it favors the development of cognitive skills (Baker, Cote‟ & Abernathy, 2003; Berry, Abernathy & Cote‟, 2008; MacMahon, Helsen, Starkes & Weston, 2007). Specifically in tennis, competition and competitive match play are the key factors for the successful development of a player, because it enables developing performance related skills (Crespo, Reid, Miley & Atienza, 2003; Reid et al., 2007; Reid, Crespo & Santilli, 2009).

1.6 Problem Statement

Despite the nature of tennis as an open skill sport that requires constant decision making, response organization, spatial awareness and in addition to a wide range of physical, psychological, technical and tactical abilities (MacCurdy, 2006), the process to produce a high performance tennis player is still a challenging task not only for coaches but also to the parents and sports organizations. Those associated with the sport will always continue their quest for excellence in performance. In tennis, as with all other sports, the ultimate goal of athletic preparation is to achieve peak performance at the required time especially during the competitions. Successful performances at major games and at important tournaments depend on a coach‟s ability to produce and

implement an effective long term training plan. There has been limited research carried out in Malaysia on effective training programme for tennis performance enhancement.

Most of the junior tennis players in Malaysia train with their own personal coaches or are involved in the junior training programme organized by tennis associations. These players will continue to participate in tournaments at national and international levels to assess their improvement. However, coaches always face problems in identifying the actual areas of weaknesses or strengths without any specific monitoring system. The findings from the evaluations may also benefit athletes and coaches by allowing them to understand and emphasize more training on the areas that the athletes are lacking in to allow a well-rounded, individualized development programme for peak performance.

A major shift in teaching methodology has been the catalyst of structuring the teaching and coaching process with the idea of adapting it to the match situation or game based approach, and thus emphasizing the role of strategy and tactics already in the initial stages of the game (Unierzyski & Crespo, 2007). The sport‟s teaching should be based on the assumption that at any moment the player may be in one of the five following game situations: 1) serving, 2) returning, 3) baseline game, 4) approach or at the net and 5) pass and lob (Tennant, 2004). Tennis players must be able to implement some specific tactics in each of these five game situations. Therefore, the purpose of the training process should be mainly focused on preparing the athletes to manage and react to these situations. Thus, the training programmes must consist of methods that emphasize on the ability of the players to make decisions effectively for responding to the situations. The technique based approach is a necessary form of teaching but by itself does not promote the effective learning of the tennis sport. On the other hand, the

tactical approach demands from the players to solve problems encountered in the match. This can only be achieved through practicing the skills where the game situations will be combined with the tactical intentions. This form will lead eventually to a complete understanding of the actual character of the sport of tennis.

According to Hohm (1987), much of the success experienced world class tennis players may be attributed primarily to their ability to produce consistent, accurate and powerful shots. These are among the tactical attributes which have been identified by United States Professional Tennis Association (USPTA, 2008). These are the tactical components that will also be measured in the International Tennis Number (ITN) On-Court assessment beside the technical skills. Currently, there is no other study has ever been conducted on the technical and tactical performance of Malaysian junior tennis players. Therefore, the purpose of this study was to determine the effectiveness of the five game situations training programme on the performance of junior tennis players. The findings can provide evidence based recommendations that can be adopted by players and coaches in the training programme with the objective to enhance tennis performance in competitions.

1.7 Objectives of Study

The aim of this study was to seek a realistic and feasible solution in order to improve and to enhance the performance of Malaysian junior tennis players as well as to upgrade the standard of their achievement at international level. The findings can be used to provide evidence-based recommendations that can be adopted by sports scientists, coaches and players in their training programme.

The objectives of this study are as follows:

1.7.1 To examine the effects of Easy Five training programme on the technical and tactical performance of Malaysian junior tennis players.

1.7.2 To examine the effects of tennis match play on the technical and tactical performance of Malaysian junior tennis players.

1.7.3. To compare the effectiveness of an 8 week of Easy Five training programme and tennis match play on the performance of Malaysia junior tennis players.

1.7.4 To examine the effects of Easy Five training programme on the agility performance of Malaysian junior tennis players.

1.7.5 To examine the effects of tennis match play on the agility performance of Malaysian junior tennis players.

1.7.6 To compare the effectiveness of an 8 week of Easy Five training programme and tennis match play on the agility performance of Malaysian junior tennis players.

1.7.7 To examine the effects of Easy Five training programme on ITN Total Score of Malaysian junior tennis players?

1.7.8 To examine the effects of tennis match play on ITN Total Score of Malaysian junior tennis players?

1.7.9 To compare the effectiveness of an 8 week of Easy Five training programme and tennis match play on ITN Total Score of Malaysian junior tennis players?

1.8 Research Questions

This thesis is seeking to address several fundamental questions in relation to understand the high performance tennis profiles and characteristics. Therefore, the study seeks to answer the following questions:

1.8.1 What is the effect of Easy Five training programme on the technical and tactical performance of Malaysian junior tennis players?

1.8.2 What is the effect of tennis match play on the technical and tactical performance of Malaysian junior tennis players?

1.8.3 Is there any significant difference between the effectiveness of Easy Five training and tennis match play on the technical and tactical performance of Malaysian junior tennis players?

1.8.4 What is the effect of Easy Five training programme on agility performance of Malaysian junior tennis players?

1.8.5 What is the effect of tennis match play on agility performance of Malaysian junior tennis players?

1.8.6 Is there any significant difference between the effectiveness of Easy Five training and match play on agility performance of Malaysian junior tennis players?

1.8.7 What is the effect of Easy Five training programme on ITN Total Score of Malaysian junior tennis players?

1.8.8 What is the effect of tennis match play on ITN Total Score of Malaysian junior tennis players?

1.8.9 Is there any significant difference between the effectiveness of Easy Five training programme and tennis match play on ITN Total Score of Malaysian junior tennis players?

In order to address the above research questions, a systematic methodology was adopted and this is reflected in the intervention programme that will be discussed in chapter 3.

1.9 Significance of the Study

The development of a champion should start from an early age as scientific research suggest that it takes eight to twelve years of training to nurture and to develop a potential and talented young athlete to be highly successful at international level (Balyi & Hamilton, 2003). A long-term commitment is required in producing elite athletes in most sports including tennis. In achieving this long-term objective, regular performance assessment is required to evaluate the effectiveness of any training program. The central involvement of the athletes in the process may boost their motivation and encourage adherence to the intervention strategies being planned. It may also facilitate the coach-athlete relationship by promoting communication and addressing any perceived discrepancies. Utilizing the findings of Birrer et al. (1986); Hohm and Klavora (1987); Roetert et al. (1992), profiling an athlete‟s performance from an early age with emphasis put on technique, accuracy, and consistency would be a more scientific based approach to tackle the quest for optimal performance. Another useful variation on the standard performance assessment is for the athletes to compare their current performance in relation to the agreed concepts with a previous best standard rather than an ideal one. Therefore, the performance assessment approach can be used to evaluate the effectiveness of any intervention and to highlight whether the athletes are making any positive progress in their training.

The findings of this study will provide important information, knowledge and guidelines for coaches, parents and players on a systematic and effective approach to become a better player and to reach the goal of international success. Tennis players looking forward to reach their full potential deserve to be trained using the most up-to-date or systematic training methods which have been scientifically proven to enhance players‟ performance. It is the responsibility of the coach to impart the latest

information and findings into a successful evidence-based training programme to enhance players‟ performance and to achieve their fullest potential. It is anticipated that from this study, players and coaches will be able to utilize the results and be able to improve future performances.

1.10 Delimitations of the Study

A threat to external validity concerns the sample being used in this study. Specifically, the samples consist of only the national elite junior players aged between 12 to 16 years old who were ranked in the National Junior Ranking System in Malaysia. It is important to note that the sample does not include the non-elite tennis players which consist of school, district and state players aged between 12 to 16 years old. Thus, the focus of this study is only on the national elite junior tennis players aged between 12 to 16 years old. This delimitation was also controlled in this study by conducting a pre medical screening on the subject before they participate in the test by a qualified physician from the Faculty of Sports Science & Recreation, University Technology MARA.

1.11 Limitations of the Study

There are some limitations in this study and they are stated as below:

a. The participants of this study comprise of the elite national players aged between 12 to 16 years old based on their current national junior ranking in Malaysia. However, the selection of the participants was based on the standard ranking procedure which means that these players participated in many tournaments or competitions as compared to players who rarely compete in the tournaments. This will affect the reliability of the study because there are many undiscovered talents in Malaysia whereby they do not

have the opportunity to compete in the tournaments because of various reasons such as financial constraints and locality.

b. Influence of the heredity aspects, the lifestyle of the subjects were not ascertained for in this study.

c. Subjects may have past injuries and may have gone for operations and clinical treatments. Players may not be able to perform at optimum level during the tests due to past injuries and this may affect the actual results.

d. Generalizations of the findings of this thesis were relevant and limited to the age range being used in this study.

1.12 Summary

This chapter has outlined the context into which this thesis is situated. This research was focusing upon the specific training programme that can be integrated into a multidimensional approach for the performance enhancement. It should be a part of many studies that have been conducted earlier on tennis players in Malaysia and be specifically reflected to the realistic situations encountered in the sport. This study employed an identified intervention programme to enhance the performance of the tennis players. The main details of the intervention programme are described in details in Chapter 3. The objectives of the study are presented clearly. The literature review in the next chapter will provide a descriptive and critical analysis of previous research, studies, techniques, theories and findings that have inspired the direction taken in this thesis.

1.13 Definition of Terms

The following terms may be understood within the context of this study.

1.13.1 Sport performance is a complex product of cognitive knowledge about the current situation and past events combined with the players‟ ability to produce the sport skill(s) required" (McPherson, 1996).

1.13.2 Training represents the physical, technical, intellectual and psychological preparation of an athlete through physical and mental training (Harre, 1982).

1.13.3 Game situation approach emphasizes the use of games and mini games to provide athletes with situations that are as close to a real match as possible (Launder, 2001).

1.13.4 Match play is characterized by intermittent exercise, alternating short (4–10 second) bouts of high intensity and short (10–20 second) recovery bouts, interrupted by several periods of longer duration (60–90 seconds) (Pluim & Safran, 2004).

1.13.5 Physical skill consists of those components of physical fitness that have a relationship with enhanced performance in sports and motor skills that involve the use of muscles to perform a learned pattern of movement (Martens, 2004*)*.

1.13.6 Technical skill is defined as the specific procedures to move one‟s body to perform the task that needs to be accomplished (Martens, 2004*)*.

1.13.7 Tactical skill is defined as the decisions and actions of players in the contest to gain an advantage over the opposing team or players (Martens, 2004).

1.13.8 Groundstroke is the shot when a tennis player hits the ball after the bounce (Sadzeck, 2009).

1.13.9 Accuracy in tennis the ability to land a shot into a certain, small area with enough margin to of safety. Accurate shots in tennis may lead to the opponents producing unforced errors (Bollettieri, 2001).

1.13.10 Consistency is the ability to perform a similar task and produce similar outcomes repeatedly. The rationale of its application in tennis is that if one can outlast his opponent, then he would gain the advantage against the opponent (Bollettieri, 2001).

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter provides some critical overview of the literature pertaining to sports performance especially on tennis. It contains the review on theories, applied models and various factors that affects players‟ performance after an intervention program. In the recent scientific literature in the field of sport sciences, research branches on sports performance are widely developing. Hughes and Bartlett (2002) stated that sports bio-mechanists and notational analysts are concerned with the analysis and improvement of sports performance. They analyzed the structure of sports, distinguishing in technical, tactical and other performance indicators. The purpose of this chapter is to review and discuss the important performance indicators proposed in the literature.

2.2. Training and Assessment

In order to improve the skills and to enhance performance in competitions, athletes must prepare themselves through a training process where the main objective is to improve body function and optimize performance. Each training phase of preparation, competition, and transition is composed of four fundamental preparations which are physical, technical, tactical, and psychological (Bompa, 1999). Tennis players adapt to training in different ways and at different rates depending on their developmental age, training exposure and performance level (Balyi & Hamilton, 2003). Therefore, it is important to monitor individual responses towards training. There are three perspectives to monitoring a players‟ adaptation. These are through the players‟ own recorded perceptions (Calder, 2006), the coach‟s observations at training and competitions (Calder, 2003; Hooper & Mackinnon, 1995), sport scientists and sport medical screening and testing assessments (Quinn & Reid, 2003). Each party involved in this process has a different role but the collective information from all parties provides a

holistic view of adaptation throughout a player‟s long term involvement in tennis (Balyi & Hamilton, 2003; Calder, 2006). Records of players‟ performance are beneficial source of valuable information. From this information, coaches will be able to monitor players‟ performance in training and during competitions. Success in tennis does not only rely on athletic abilities and training but also on many other factors. The progressive development of a world class tennis player is a long-term process that researches have suggested it takes a minimum of 10 years or 10,000 hours (Ericsson, 2007). Further researches show that world class players go through distinct phases of talent development.

According to Bloom (1985) and Gibbons (1998), elite players‟ development is divided into three stages:

a. **Introduction to tennis or development of tennis fundamentals**

One variable in this stage that is particularly important to the development of tennis player is the acquisition of tennis fundamentals. The successful acquisition of fundamental is the cornerstone of continued physical, psychological, technical and tactical development as the player moves through the developmental stages.

b. **Refinement or developing into a better tennis player**

During this phase, the players evolve into a serious and focused athlete. At this phase, the player will be putting more effort in training and working on improvement in every aspect of important performance factors.

c. **World Class tennis performance**

This phase is marked by hours of training and the honing of technical skill and expertise into personal excellence while competing at the highest level of competition. In the world class performance stage, the players must find ways to continually challenge and motivates themselves because performance gains will come progressively.

World Class tennis players are developed through stages (Lubbers, 2005). Certain skills are emphasized during each stage and it is important that tennis coaches follow each stage properly in an attempt to produce champions. Sporting success depends upon having a structure in place that supports talented young athletes every step of the way. Coaching, competition, facilities and support services need to be available at the appropriate level throughout the system not just at the elite end of the sport. Creating a linked and progressive system of talent development is crucial in the effort to provide an opportunity for the champion to emerge. Lack of sufficient information concerning components of performance and player development has been one of the main reasons for the loss of gifted young players from tennis and for the infamous burn out syndrome (Gould, 1997). Obviously, knowledge of the factors that determines performance and progress in tennis as well as data about desired training loads, the number of matches a young player should play and other contributing factors are an important base on the theoretical and practical points of view.

In a tennis match, if a junior player appeared to show a sign of fatigue in the third set, an effective coach would be able to observe this and design a training program to solve this situation. Similarly, if psychological factors require attention, the intervention must be adjusted to specific requirements. The key problem for coaches seeking to address such issues is how to identify the problems when they cannot observe what is going on in their athlete's mind. A direct question does not always provide the full facts since athletes can be reluctant to discuss such things. A recommended approach is by using performance profiling method which is useful for assessing the performance factors of the athletes. The assessment provides information for coaches to make effective analysis on athletes‟ performance.

According to Elliot (2010), a systematic approach to analysis requires five stages as shown in Figure 2.1. This systematic approach will allow coaches to observe, evaluate athletes‟ performance and analyze athletes‟ performance at all level of development. The information can be used to develop training schedules to help athletes to improve those areas perceived relatively weak.

Figure 2.1: 5-Stage Analysis Process – A key to effective analysis (Modified from Knudson & Morrison, 2002)

2.3. Developing Performance Excellence

In the literature talent refers interchangeably to an athlete‟s preconditions for success (i.e. innate potential) and to the outcome of the developmental process (i.e. athletic excellence during youth) (Helsen, Van Winckel & Williams, 2005; Tranckle, 2004; Williams & Reilly, 2000). Bloom (1985) conducted a study to understand how world-class talent has been developed. One of the most common versions of the unitary conception of development in sport occurs when the assessment of ability in an area is

reduced to levels of current performance. Abbott and Collins (2002) argued on the need to distinguish between determinants of performance and determinants of potential skill acquisition. It seems more plausible that individual development is the result of an interaction between inherited abilities, social and cultural learning (Scarr & McCartney, 1983) and it is the interaction of processes that undermines simplistic correlations of ability and performance. Current performance can be a poor indicator of ability, since it is mediated through a host of other influences, such as training, support, parental investment and societal values (Bailey & Morley, 2006; Holt & Morley, 2004). However, it is commonly accepted that training will bring significant changes to any athletic ability or performance. Athletes‟ performance development is the key feature in any comprehensive sports coaching theories and models.

2.3.1 Competition and Match-Play

Some studies indicate that time spent on competition and match-play is a basic factor in expertise development, and that it favors the development of cognitive skills. Competition has also been identified by expert athletes as the most useful activity to develop perceptive-decision skills (Baker et al., 2003; Berry et al., 2008; MacMahon, Helsen, Starkes & Weston, 2007). In tennis, competition and competitive match-play is a key factor for the successful development of a player, because it enables developing performance related skills (Crespo, Reid, Miley & Atienza, 2003; Reid et al., 2007; Reid, Crespo & Santilli, 2009). Furthermore, time and the number of competitions are not the only relevant factors in developing expertise since the level of competitions has also been identified as a factor that may contribute to the development of cognitive expertise in intermediate level tennis players (Côté, Ericsson & Law, 2005; Crespo et al., 2003).

Participation in competition brings players closer to an expert knowledge profile, developing more specific procedures applicable to game situations (McPherson & Thomas, 1989). Consequently, it can be interpreted that competition is a basic activity for expert performance (Baker et al., 2003), and also for the development of cognitive expertise. Furthermore, as indicated by Reid and colleagues, experience in competition or match-play is a performance predictor (Reid et al., 2007). Participation in competition has also proven, in other studies, to be one of the activities that favor the development of skills (Baker et al., 2003; Ward et al., 2007). The same occurs with the number of competition opportunities, because some studies have indicated that competition opportunities can determine the development of tennis players in a specific way (Crespo et al., 2003). So, it could be suggested that competition in tennis is an important factor for tennis players‟ cognitive development (Crespo, Miley, & Couraud, 2001; Reid et al., 2007). The necessity to participate in competitions is also justified by their nature since match-playing is the most specific activity which enables players to implement their achieved skills, thus becoming one of the best examples of deliberate practice (Berry et al., 2008).

As stated previously, competition is a basic activity for expert performance (Baker et al., 2003) and it is important to provide athletes with opportunities to compete, understanding competition participation as a formative activity, regardless of the result accomplished (Berry et al., 2008). The level of competition is also important for the player‟s development (Crespo et al., 2003). Several advantages may arise as a result of extended engagement in sport-specific play activity, where and when participants are allowed to experiment with different skills, techniques and tactics within their sport. Such conditions create the opportunity to innovate, improvise, and respond strategically, recreating those conditions that are important at elite level (Williams, Ford, Eccles &

Ward, 2011). Experience developed in competition or in similar activities (e.g. game play training) may predict performance levels (Reid et al., 2007).

2.3.2 Game Based Approach

Findings of researches (Bunker & Thorpe, 1982; Thorpe, Bunker & Almond, 1986; Thorpe & Dent 1999), observations of careers of many top tennis players and experience of the most successful coaches gave a base for a new teaching and training philosophy. This new concept of coaching methodology has been identified to assist the process of teaching with the idea of adapting it to the match situation and hence emphasizing the function of tactical approach to coaching. While the ability to perform a skill effectively is critical to performance, appropriate decisions concerning what to do in the game situation are equally important. Therefore, the aim of the tactical approach to coaching tennis is to improve the overall game performance of the player combining tactical awareness and skill execution (Crespo & Cooke, 1999). The "new" methodology appeared to be successful not only in tennis but also has found support among physical education practitioners in Europe and the USA (Griffin et al., 1997; Turner, 2001). Research (McPherson 1991, McPherson & French 1991; Turner 2003) confirmed that because of tactical and game based approach, tennis players demonstrate better game performance such as shot precision as well as decision making and also have higher level of specific knowledge than players who are coached according to traditional approach. It is very important to use modified games (Wright et al., 2005), which engage pupils cognitively; stimulating pupil interest; allowing for more game play; and provide pupils the opportunity to transfer concepts from one game to another.

The most widespread method is the "Teaching Games for Understanding" (Bunker & Thorpe, 1983) that was later developed by Mitchell, Oslin and Griffin (2006). This

tactical approach method places first the "what to do" before the "how to do". That means that the role of the declarative knowledge ("what to do"), in the performing and learning environment, precedes the procedural knowledge ("how to do"). Therefore, if the instructions given from coaches to athletes, when performing a skill, lack of tactical knowledge then they will never acquire the necessary tactics to become competitive (Nevett, Rovegno, & Babiarz, 2001). Teaching the sport of tennis to children means the necessity of teaching a range of the required technical skills and the momentousness of progressively introducing, at the same time, a series of tactical intentions. The sport's teaching should be based on the assumption that at any moment the player may be in one of the five following game situations (Tennant, 2004):

1) serving
2) returning
3) baseline game
4) approach or at the net
5) pass and lob

In each of these situations players must implement some specific tactics. For this reason, the purpose of the training process should be primarily focused on how the athletes will be able to manage and react to these situations. Thus, the training programs should now include methods that emphasize to the ability of the players to take effective decisions for responding to the incoming motor incentive. The technique based approach is a necessary form of teaching but by itself does not promote the effective learning of the tennis sport. On the other hand, the tactical approach demands from the players to solve problems encountered in the match. This can only be achieved through practicing the skills where the game situations will be combined with the tactical intentions. This form will lead eventually to a thorough understanding of the real

character of the sport of tennis. Concluding, the first and the main outcome of modern tennis practice should be teaching skills not through conscious motor control but through an implicit process, such as the tactical implementation of the skills. That means that a study, like the present one, is of great importance because it aims to assess the effect of external attention on game performance thoroughly. This is believed to produce significant knowledge, used by the coaches, for the development of young players.

2.3.3 The Theory of Deliberate Practice

Talent is both an appealing and a common-sense explanation of what underlies the skills in sport and most of the coaches believe that differences in talent will determine who will succeed (Helsen, Hodges & Winckel, 2005). Alternatively, sport performance and expertise could be the result of hours spent in focused and effortful training rather than the effect of innate and inheritable traits (Baker, 2003), a position that has its roots in The Theory of Deliberate Practice presented by Ericsson et al. (1993). They have defined deliberate practice as any activity that has been designed to improve current performance that is effortful and not inherently enjoyable. Their primary prediction suggests that the amount of time an individual is engaged in deliberate practice activities will be related to that individual‟s acquired performance. They also suggested that for the attainment of expertise, it was not just the types of training but the engagement in „deliberate practice‟. Deliberate practice is made up of activities done to develop requiring the abilities that are not intrinsically motivating, requiring effort and attention and not leading to immediate social or financial rewards. Central to the notion of deliberate practice is the assumption that a direct relationship exists between the number of hours of deliberate practice and the performance level achieved (Hodges & Starke, 1996). A substantial body of evidence also suggests that elite performances

require about 10 years of practice to acquire the necessary skills and experience to perform at an international level (Helsen, Starkes & Hodges, 1998). Despite the relationship between hours of deliberate practice and the performance level achieved, Helsen et al. (1998) has indicated that a theory of expertise based solely on deliberate practice is still questionable. It may be that, those who are more talented are more motivated and consequently in more practice (Helsen et al., 1998). Furthermore, they noted that number of the data would be suggesting that the most critical part of producing skilled athletes is to identify individuals who are highly motivated and are likely to persist over the long period required to produce a champion.

2.4 Performance Analysis and Assessment

Another crucial factor to performance enhancement in sports is the performance testing and in order to be competitive, the key is to select tests that provide information specific to the particular sport, position, or event (Muller, Benko, Raschner & Schwameder, 2000). Performance analysis is essential to enable coaches and players to assess the requirements of individuals and teams to be able to produce a better understanding of how future performances can be improved (O‟Donoghue, 2010). An important application of performance development in sports involves measurement and evaluation of physical factors that relate to athletic performance. Research that has been conducted over the past several decades has generated a substantial body of knowledge regarding the factors that determine performance in many types of sports. Improving tennis performance is the goal of every tennis scientist, coach, and players. Researchers and coaches examine player movements, game patterns, tactics and traits without bias; all in an attempt to formulate ways in which players or teams can maximize their prospects of winning (Over & O'Donoghue, 2008). Indeed, in tennis, several studies (Gillet & Leroy, 2009; Reid, McMurtrie & Crespo, 2010; Takahashi et al., 2009) have

determined how match statistics describe and explain a player‟s success. The practicality of this information should be applied when designing training programs for high performance tennis players. Age, sex, style of play, physical components, technical components, tactical components, and psychological components will all determine the success of the tennis athlete (Kovacs, 2006). Effective planning and training programs will help in designing a safe, effective, and productive program design to help optimize performance.

Normally, analyses of sport performances are conducted to obtain quantitative data on the characteristics of the sport skills of different athletes. From this type of data, characteristics that are common to elite athletes can be identified. Subsequently, this information provides coaches and researchers with comparative parameters for their athletes to strive to attain peak performance. Athletes, coaches, and managers need to understand the importance of observing, analyzing and evaluating sports skills and techniques when trying to enhance performance. Often, past research has involved in developing physical profiles of successful athletes in a particular sport, comparing those profiles with the normal person‟s profiles or less successful athletes and ultimately conducting intervention studies to determine if enhancement of selected physical factors enhances performance. Roetert et al. (1992) have observed higher correlations between the tennis strokes and national rankings than between the tennis strokes and sectional rankings. Except for the backhand stroke, which did not have a significant correlation with sectional rankings, each stroke was significantly correlated with national rankings.

As stated by Roetart et al. (1992), the most remarkable finding of this investigation was that the physical performance tests in advanced young male tennis players (8 to 12 years old) who did not predict their ability to play tennis at a competitive level. Data

from this study did indicate that skills related to tennis strokes may be used to predict success at this age. The lack of physical maturation in males during this age period (8 to 12 years) could be a major explanation for why physical performance was not related to tennis rankings. Dramatic increases in strength, size, and endurance typically occur in boys between the ages of around 12 to 15 years. As tennis players mature, it seems that the major factors affecting their performance change.

In a study that expanded on that by Roetert et al. (1992), three levels of elite junior tennis players were tested: USTA National Team (mean age 15.4 years); Development Camp (mean age 13.6 years); and USTA area training centers (age not specified). An analysis to classify rankings with performance tests was able to classify 91.4% of cases correctly. As technical stroke production appears to influence rankings more than physical ability in the younger players, Roetert et al. (1992) suggested that their training should concentrate on effective and efficient stroke mechanics, improving technique and ball placement, with less emphasis on physical conditioning until they reach puberty and beyond. However, a sufficient minimal physical fitness level is still required to endure practice and match sessions. Of course, it would be anticipated that future physical profiles on that athlete would reflect the desired improvements in key variables. By defining these parameters, one can make some predictions regarding performance capabilities, assess an athlete's predisposition to injury, critically review the effect of current training protocols and provide the coach with additional insight along with a competitive edge over those programs relying primarily on subjective criteria (Roetert, Piorkowski, Woods & Brown, 1995).

According to Hughes, Evans and Wells (2001), the coaching process is about enhancing performance by providing feedback on the performance to the athlete or

team. Researchers have shown that human observation and memory are wonderful even though they are not reliable enough to provide accurate and objective information for high-performance athletes. Objective measuring tools are necessary to enable the feedback process. The essence of the coaching process is to instigate observable changes in behavior. The coaching and teaching of skill depends heavily upon the analysis to effect an improvement in athletics‟ performance. Informed and accurate measures are necessary for effective feedback and improvement of performance. In most athletic events, analysis of the performance is guided by a series of qualitative assessments made by the coach. Franks, Goodman and Miller (1983) have defined a simple flowchart of the coaching process (Figure 2.2). This outlines the coaching process in its observational, analytical and planning phase. The coach will observe and form a conception of positive and negative aspects of the performance. Often the results from previous games as well as performances in practice are considered before planning in preparation of the next match. The next game is played and the process repeats itself.

However, there are problems associated with coaching process that relies heavily upon the subjective assessment of game action. During a game, many occurrences stand out as distinctive features, ranging from controversial decisions given by officials to exceptional technical achievements by individual players. While these are easily remembered, they tend to distort the coach's assessment of the total game. Most of the remembered features of a game are those that can be associated with highlighted features of the play (Hughes et al., 2001).

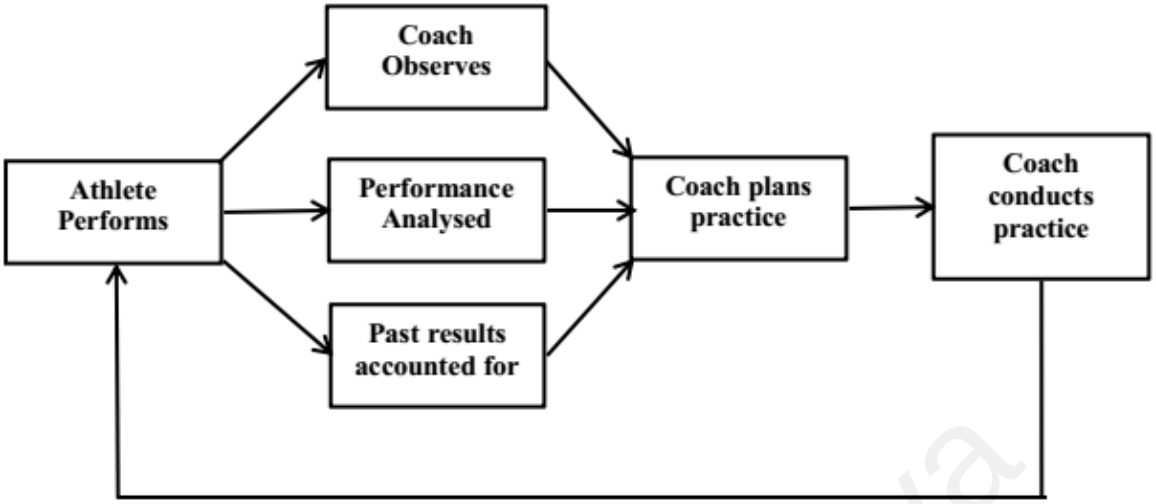

Figure 2.2: Schema of the Coaching Process (Franks, Goodman & Miller, 1983)

Human memory is limited so that it is almost impossible to remember all the events that take place during an entire competition. Franks and Miller (1986) showed that soccer coaches are less than 45% correct in their post-game assessment of what occurred during 45 minutes of a soccer game. Problems associated with subjective assessments would seem to present the coach with insurmountable difficulties, particularly if improving the performance of the athlete hinges on the observational abilities of the coach. Despite the importance of observation within the coaching process, very little research has been completed into observational accuracy and has clearly demonstrated that coaches cannot be expected to remember even 50% of a performance in most cases. One of the coach's main tasks is to analyze accurately and assess the performance. It would seem this could not be carried out subjectively. Any hopes for improvement through feedback would be reduced to chance.

In any sporting situation, it is difficult for coaches to notice and to remember all the key events occurring within a training session or match by being equipped only with their knowledge of the sport and their innate ability of observation. It is a fact that there are severe human limitations to where observing and analyzing performance is

concerned and the same goes to coaches, no matter how skilful they are, to be able to do so. Their perception of events would not be a copying process but rather a selective and constructive one (Reilly, 1996). Then coaches will be able to provide an objective and unbiased information. Therefore, performance analysis is needed to provide such information and analysis.

Yet, analysis based on accurate observation and assessment is a key tool for improving future performance. That is where the relatively new discipline of performance analysis comes in. Established over the last decade and facilitated by advanced technology, performance analysis (PA) is now acknowledged as an aid to performance enhancement at all levels. Essentially, PA is about creating a valid and reliable record of performance by means of systematic observations that can be analyzed with a view to facilitating improvement. The early work of Sanderson and Way (1977) and Hughes (1986) highlighted that the formation of a database of matches could provide information regarding patterns of play that could be considered representative of the subjects used to form the database. The formation of profiles of different groups of players could be a very powerful tool in attempts to understand the performance better and to formulate a successful game-plan prior to competitions. As such, a number of studies over the years have attempted to profile different type of players and aspects of the game. Hughes and Franks‟s (1994) performance analysis study provided profiles of the performance patterns of male squash players at four different ability levels. These profiles provided a great insight into the physical demands of the game and as such had a great practical application in the creation of squash specific training drills or interventions.

Performance analysis should give coaches and players an objective view on the performance of their skills. Coaches should break down everything in such details that systematic observations will give good feedback on the progress made. The process provides the athletes and coaches with objective information that helps them understand performance better. This process also is underpinned by systematic observation, which provides valid, reliable and detailed information relating to athletes‟ performance. Performance analysis can help to enhance the coaching process by providing statistical and empirical information or data. This objective data facilitates enhanced feedback between coaches and athletes. Subsequent interventions can then lead to a greater performance impact. Coaches may want to question the need for performance analysis as a separate activity, given that observation and analysis clearly form a crucial part of the coaching process as outlined in Figure 2.3 (Cross & Lyle, 1999).

Analysis based on accurate observation and recall is a key tool for improving future performance (Bishop, 2008). The integration of performance analysis in the coaching process was investigated by Bishop (2008) and he addressed the importance of creating a reliable record of performance to enable systematic observations that can be analyzed with a view to facilitating change. While coaches are expected to be experts at observing and analyzing performance, research has pointed that there are still limitations within these processes. Bishop cited two key studies from the Journal of Sports Science and Journal of Sports Behavior which highlighted memory retention problems with coaches able to recall only 30-50% of key performance factors they had witnessed even with special training in observation.

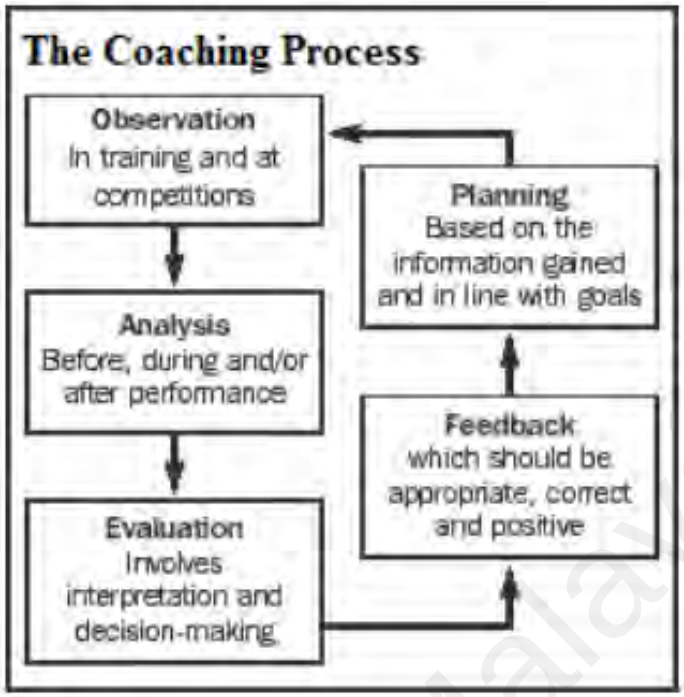

Figure 2.3: The Coaching Process (Cross & Lyle, 1999)

Although many professional coaches are able to anticipate the situations and make appropriate changes to influence athlete‟s performance even successful coaches are prone to human error which lead to wrong decisions; hence the need for a systematic performance analysis approach within coaching practice using valid and reliable data to monitor and to assess athlete‟s performance. Without such approach, coaches are liable to form biased opinions of their athletes‟ or players‟ performances leading to potentially incorrect substitution decisions or training prescriptions. Technological advances and declining costs have given coaches access to computers, digital cameras and analysis software making the whole process of Performance Analysis simpler and less arduous. According to Bishop (2008), this process can be used to identify and measure a range of performance indicators that have a real bearing on the outcome of any given sports and therefore, providing a better understanding of how success can be achieved at all levels of performance which include tactical, technical, physical and psychological indicators.

2.5 Performance Indicators

Performance indicator is a term for those variables that are demonstrated to be valid measures of important aspects of performance" (O'Donoghue, 2010). Hughes and Bartlett (2002) carried out a study on the use of performance indicators in various sports. Within this study they explained that 10 performance indicators were "a selection or combination of action variable(s) that aim to define some aspect, or all, of a performance" (Hughes & Bartlett, 2002). They then continued by subscribing to the idea that performance indicators are a good way to measure whether an athlete's performance was a success or not. Hughes and Franks (2008) explained that performance indicators are used in in the analysis of sports performance to improve the future performance of a team or individual. Choi, O'Donoghue and Hughes (2007) explained that in sport, if one athlete/team wins a match, it does not necessarily mean that they played better in all aspects of their game compared to the person they beat. They continued by stating that in tennis in particular, ones performance as a whole would not be replicated in every set of the match. Taking this into consideration, it is essential that valid performance indicators are separated in time; i.e. sets so the statistics are not overlooked by the result of the match.

Over the years, studies investigating tennis strategies have been carried out but have been unsuccessful on agreeing the sets of variables that could be used to represent different strategies (O'Donoghue, 2010). As previously mentioned by O'Donoghue (2010) there are limitations surrounding the subjective observations within performance analysis. Hughes and Franks (2004) explained that feedback was crucial for the improvement in performance of athletes.

Performance indicators provide data, and statistical analysis of them allow to identify tactical solutions and player‟s individual strategies which help us to understand the tennis‟ characteristics and the reasons that contribute to a better performance (Filipcic et al., 2009; Katić et al., 2011).There are a large number of studies that have considered winners and errors as performance indicators to predict tennis match outcome and the playing style of the players (Djurovic et al., 2009; Filipcic et al., 2009; Hughes & Clarke, 1995; Katic et al., 2011). Katic et al. (2011) assessed the correlation among various tennis performance indicators and match outcomes at Wimbledon and Roland Garros tournaments. Study results showed the winners to be more aggressive than losers in the total sample, having a higher percentage of points achieved to the opponent‟s service, and more winners and breaks.

Analyzing different variables and the latent factor of a tennis match, Djurovic et al. (2009) identified five structures such as: match successfulness, first serve significance, serve speed, net play and playing errors. The fifth factor, playing errors, was defined as unforced and double-fault errors. They found that won matches were characterized by a lower number of double-fault and unforced errors than lost matches. Martínez-Gallego et al. (2013) analyzed movement characteristics of elite tennis players in relation to the direction of groundstrokes and found that there were differences between winners and losers. Winners indicate more distance of movement characteristics as compared to losers.

2.6 Reviews on Performance Skills

There are several ways to provide feedback on the training intervention program but the performance goals set by the players are quantified in terms of technical, tactical, mental and physical assessments.

2.6.1 Studies on Physical Components

Tennis is considered as one of the most popular and professional sports. Over the past few years, high participation rates have raised overall performance at the elite level. Improvements in performance particularly at the elite level largely depend on the application of scientific knowledge to increase the quality of training programs (Muller et al., 2000). Physical, technical, and tactical skills are all important to performance in racquet sports (Lees, 2003). However, unlike many other sports, which may require high levels of physical fitness in a few components, tennis players require high performances in most components such as speed, agility, strength, power, aerobic endurance and balance (Kovacs, 2007). A major determinant of the outcome of a tennis match is the player's physical fitness, which enables them to repeatedly generate power, explosive strokes and rapid court movements during extended tennis matches (Konig et al., 2001). Hughes and Moore (1998) analyzed the patterns of movement concerned with serve and volley tactics in tennis. They indicated that certain types of movement like skip-check combined with the ready position were used almost by all players, however, some movements such as running or jumping through a shot placed pressure on the players often resulted in them losing the rally. As demands of professional tennis have increased, a player‟s physical capabilities and characteristics have a larger impact on their level of success. One aspect of the improved performance in overall in the professional tennis relates to the significant increase in the importance of a player‟s physical characteristics (Morante, 2006). A player‟s physical capabilities and attributes give a larger impact on their achievement.

The science of training in professional tennis has significantly increased over the past decades in response to various factors such as increased in standard of play, commercial values, competitive pressures and heavier tournament schedules. In order to be

competitive at this level, players must spend more hours in physical conditioning off and on the tennis court to complement their activities and match practice. These are important areas to maximize competitive performance (Morante, 2006). Competitive tennis play requires a combination of major physical variables. Kovacs (2004) recommended that tennis athletes to be trained in a specific manner to improve tennis-specific performance. Kovacs (2004) stated in his study that training drills should simulate the time requirements experienced during match play (5 to 20 seconds) with appropriate work to rest ratios (1:3 to 1:5). As speed, agility, and maximum velocity movements respond to specific and individualized training, it is important that tennis players focus on training distances seen during match play (20 meters) with drills combining linear, lateral, and multidirectional movements. Chandler (2001) has recommended that the coach or trainer examined their training program in response to the question that fitness is important for a tennis match. It is implying that players and coaches should ensure their training program is specific to the demands and characteristics of a tennis match. Specific training has the benefit of enhancing the areas essential to the sport, which will increase the quality of training and in order to achieve specificity in a training program, the demands and characteristics of actual competitive tennis must be identified (Muller et al., 2000).

Tennis is a type of sport which is characterized with short and intermittent efforts of an altering intensity and time where numerous factors determine the achieved success which includes human's morphological body build, motor abilities and efficiency of the energetic systems (Mateusz, 2010). Tennis does not have time limits on matches unlike many other sports. This can result in matches lasting less than one hour or as long as five hours. Since there are no time limitations in the matches, very often prolonged physical effort with high intensity is required from a player, as well as an ability to

adjust to altering climate conditions such as high temperatures (Jarocki, Markiewicz & Starosta, 2001). This variability requires successful tennis athletes to be highly trained both anaerobically for performance and aerobically to aid in recovery during and after play.

Good aerobic capacity is important for recovery during play and between sessions. Kovacs (2006) has recommended that tennis athletes strive for Vo_2max values greater than 50 ml/kg/min. Some of the previous research has suggested that tennis is an aerobic sport because of the long duration and moderate mean heart rate values during play (Bergeron, Maresh & Kraemer, 1991). In tennis matches there is a general trend toward an increase in Vo_{2max} and heart rate as the game progresses, with a decrease during the rest periods while changing ends (Bernardi, De Vito & Falvo, 1998). Vo_2max values in competitive high level tennis players have varied between 44 and 69 ml/kg/min with the overwhelming majority of values greater than 50 ml/kg/min (Bernardi et al., 1998). These Vo_2max values would classify tennis players as being highly trained (Green, Crews & Bosak, 2003). However, study also found that players who were considered to be aggressive attacking players had lower Vo_{2max} values during play than baseline players (Bernardi et al., 1998). This information should be applied when designing training programs specifically for different styles of play. Therefore, training should be tailored to a player's specific playing style.

According to Born (2000) in his study on the movements of tennis players on the tennis court, he stated that a tennis player needs to make constant explosive movements on court and constantly change direction and jump. This must be done very often and over a period of 1 to 3 hours with several pauses in between. Based on his findings, it becomes certain that tennis players need to be trained in all of the different aspects of

physical fitness such as speed, strength, power, endurance, agility, flexibility and balance. Based on a survey to the top coaches in Germany by Born (2000), he found that for most coaches, footwork and speed are the most important factors determining the ultimate success of the players. He has conducted an observation and experimentation at the University of Sport in Cologne and yielded the following results:

a. Average distance covered to complete a stroke is 5 meter.
b. Most play situations (75%) under time pressure happen around the baseline.
c. A very common movement pattern is a fast run to the forehand corner followed by an explosive change of direction.
d. Lateral running at the net happens only 10% of the time.
e. Runs from the baseline forward only happen 15% of the time (Average of 7 meter, maximum of 10 meter).

Born (2000) has concluded from the findings of his study that the improvements in tennis performance were the result of improvements in the quality of direction changes and of improvements in leg strength. It has also been identified that linear speed is one component of tennis movement however it is still less than 20% of all movement on a tennis court (Kovacs, 2009; Weber, Pieper & Exler, 2007). The majority of tennis movement is multi-directional (specifically lateral), and this needs to be the major focus of movement training for tennis. Developing speed and quickness over short distances (<10 meters) will continue to be the focus of speed training programs for elite players over the coming years.

Tennis is a sport based on unpredictability of the nature of the game such as the unpredictability of point length, choices of shot selection, strategy, match duration, weather and the opponent game style which all influence the complex physical aspects

of tennis play. Designing and implementing training for tennis requires a solid understanding of the many physical variables critical to optimal performance. There have been some good practical researches studying on links between physical fitness components, age, and tennis ranking among the competitive junior players. Correlation studies have been undertaken by Roetert et al. (1992) to determine which physical components have a strong relation with the match results and ranking. The most remarkable finding of the study was that, the physical performance tests in advanced young male tennis players between the ages of 8 to 12 years old did not determine their ability to play tennis at a competitive level. However, agility was identified as the physical ability that most influenced at the competitive level of the young tennis players. Data from the study by Roetart et al. (1992) did indicate that skills related to tennis strokes may be used to predict success at the age group of 8 to 12 years old. The lack of physical maturation in males during the age period of 8 to 12 years old could be a major explanation for why physical performance was not related to tennis rankings. The study also found that dramatic increases in strength, size and endurance typically occur in boys between the ages of between 12 to 15 years. As tennis players mature, it seems that the major factors affecting their performance alter (Roetert et al., 1992).

Tennis has often been described as a game of continual emergencies because with every shot hit by the opponent, a ball can have a different velocity, a different type and rate of spin is placed in many different parts of the court (Groppel, 1986). This complexity required the tennis athletes to have faster reaction times and explosive speed. Tennis players need to be as exceptional movers in a linear direction but also in lateral and multidirectional movements. A rather practical research study tested the relation between acceleration, maximum velocity and agility in soccer players. It appears that these three variables are individual and each specific quality is independent

of the other (Little & Williams, 2005). Thus, it is important to train the tennis players in the specific movement patterns that are encountered during match play. If specificity principles are used to design training programs, it would also seem to be sensible to train the tennis athletes using sprint activities that are no longer than the furthest distance that the athlete would run for every shot, during a point. A training program consisting of stop-start sprints of not more than 20 meters would be appropriate. It is an inseparable component of the footwork which is the main determinant of proficient movement on a tennis court (Petersen, 2006).

2.6.2 Studies on Technical Skill

Technique can be characterized as a specific sequence of movements or part of movements that been used to solve movements related to tasks in sport situations (Schonborn, 1999). Technique can be optimally developed if it is seen as part and parcel of a whole system. This means, that primarily a system has to be developed. According to Schonborn (1999), modern technical training should concentrate on two main aims:

a. Create new, direct relationships between conditioning and technical elements using real game situations.

b. Establish training forms which resemble match situations but which can be successfully solved during training. In other words: train all rally variations that are more often than not, unsuccessfully resolved during matches.

Training in a real game situation will allow coaches to fully exploit the benefits of a Game-based Approach where players will be able to encounter a competition atmosphere. This type of training will enhance the transfer of learning from practice to match play by allowing coaches to re-create and manage the components that occur in tennis shot. Technically, tennis is a demanding sport. Every incoming ball is different,

reaching it on time and hitting it back effectively requires well developed technical skills. That is why it is a fundamental for developing technical skill and optimal use of other motor abilities as speed and strength. Learning of final or complete technique (Schonborn, 1999) must be preceded by developing of general, specific coordination and gaining skills similar to tennis. Another important matter is that in all major methods it is aimed to teach both reception (ability to judge correctly the flight of the ball and move to the position to play particular shot) and projection (ability to develop the techniques) skill (ITF Coaches Manual, 1994). Effective implementation of strategy and tactics requires tennis specific technical skills (Thorpe & Bunker 1997; Crespo & Reid, 2003). In today"s tennis, technique is seen as a function of the correct biomechanical principles and as a mean to implement tactics more efficiently. Each movement should be treated as a tool useful to solve tactical problem. Consequently, the perfect strokes does not exist; "strict imposition of certain grips, stances, backswings and follow-throughs is not recommended (Crespo et al., 2003). The goal of technical development is to structure an individualized model of performance and every player has a right to execute strokes individual way but with the respect of biomechanical principles.

Focusing on correct tennis techniques of all strokes at an early age is critical. It is crucial not to be misled by good ball hitting skills or physical abilities. Tennis coaches should focus on developing a solid technical base which is taught in the framework of tactical situations. Furthermore, the use of different tactical situations allows practice sessions to remain challenging, exciting and fun in addition to prevent tennis players from becoming stale or bored (Roetart & Harmon, 2005). This is especially important with talented tennis players. Basic tennis principles for groundstroke should include the development of consistency, depth, placement, spin and power. It is generally accepted

that correct tennis technique should be developed at the age of 14 for boys and 12-13 for girls (Roetart & Harmon, 2005). Additionally, at this point of time the work should begin on the tennis development of a particular game style. Tennis players and coaches should be in agreement as to the best game style for future success. Game styles can be described categorized in four basic styles as (USTA, 1996):

a. Counter-puncher
b. Aggressive baseliner
c. All court players
d. Serve and volleyed

Since the mastery of a tennis stroke or particular style takes years of practice, it is imperative to begin the process as early as possible taking into consideration of each tennis player's level of physical and mental maturity. Talented tennis players should be allowed to develop a wide variety of shots so they have some variation of skills and are not limited in having just one game style only. Schonborn (1999) has recommended that when developing the technique of tennis players, there are several goals that should be set:

a. Perfect and consolidate the strokes.
b. Permanently integrate almost all of the conditioning-energetic preconditions.
c. Make available thousands of minimal, program-altering possibilities.
d. Provide for variability of strokes.
e. Allow for application of extensive technique.
f. Develop flexible technique.
g. Provide for complexity of movement actions.

According to Schonborn (1999), modern technical training should concentrate on two main aims:

1. Create new, direct relationships between conditioning and technical elements using real game situations.
2. Establish training forms which resemble match situations, but which can be successfully solved during training.

Learning technical skills is not complete until players can improve how they read the situation and make good decisions about when to execute the technique and, most importantly, when to not do it or adjust it.

2.6.3 Studies on Tactical Skill

Tactical skills play a predominant role in tennis performance at all levels and that the improvements made in player‟s strategic and tactical prowess are essential for optimal performance development. In sports performance, strategy and tactics are inter-related. According to Crespo and Reid (2009) a strategy is defined as "the overall game plan for a certain match. In this context, tactics are how exactly a strategy will be executed. Accordingly, a tactic refers to the practical application of the strategy during the match (Crespo & Reid, 2009). A strategy is planned prior to competition that will make best use of the player‟s strengths while limiting the effects of any weaknesses (O‟Donoghue, 2010). At the same time, the strategy should seek to exploit any weaknesses of the opponent while avoiding situations where the opponent can utilize their strengths. Tactics are moment to moment decisions made during the competition by players based on the options available to them and the perceived risks and opportunities associated with these options (Fuller & Alderson, 1990).

There are many different types of tactics in tennis including service tactics (Unierzyski & Wieczorek, 2004) and shot placement (Hughes & Clarke, 1995). Tactical skills influence the success performance of players in matches and can be a key indicator of performance. Performance indicators are used to represent important and valid aspects of sports performance including tactical aspects (Hughes & Bartlett, 2002). Gilbert and Jamison (1993) suggested that the best players in the world come to matches armed with a strategy that starts when the first point is played. However, developing strategy is not an easy process and there are many potential difficulties. Although some researchers state that a tactic cannot be automated (Solá, 2005) but in the case of professional tennis tactics in top performance tennis, the rhythm is so fast that the player has no time for a decision making process to choose between different options (Crespo & Reid, 2002). Instead, the player has incorporated the right decision through extended practice in such a way that when facing that situation during a match, the tactical response is immediate and becomes automatic. When the player can automate his tactical decisions after having worked endlessly during training, the main consequence is that the player achieves confidence in his tactical patterns and how he plays (Piles & Crespo, 2012). According to Piles and Crespo (2012), top level players have a more defined, clear, solid and consistent game pattern than lower level players. This is so because they have managed to achieve a tactical automation or a more efficient decision making where they can react tactically with greater speed and efficiency than others and as a consequence, their tactical options are well consolidated. But apart from the purely tactical benefits, achieving great tactical automation has helped a player to improve not only tactical but also a key mental aspect which is confidence.

Tactical awareness is identified as ways of playing to gain an advantage over opponents, for example, a fast break in basketball (Hopper & Bell, 1999). Based on a games classification system, strategic understanding and tactical awareness can be taught as concepts that transfer between games. Strategic understanding is identified as understanding ways of playing, for example, getting the ball back into play when playing tennis. The principles of play are the basic elements of play that structure effective game playing. For example, in net games the primary rule is essentially to get the object into the area of play more often than the opponent. This primary rule leads to progressive principles of play that are consistency, then placement of the object and positioning in relation to opponent‟s target area and finally spin and power to make it difficult for an opponent to get the object back into play (Hopper, 1998). The principles of play give an effective framework for progressively teaching the students the strategic understanding to be successful game players. However, understanding these principles does not happen for players from simply being told or shown. According to Hopper (1998), players need to be taught the principles of playing, repeatedly, within gradually developing modified games that enables the players to appreciate and realize how to gain an advantage over an opponent.

As previously highlighted that stroke production should be the main concern in training younger players, the outcome measure that fits the evaluation process would not only be the technique of the stroke, but also the outcome of the stroke itself. Thus research-based practice has looked into consistency (Craig, 2002; Martinez, 2002; Van Aken, 2002) and accuracy (Davey, 2002; Lyons et al., 2013) of the stroke placement for the matter as stroke kinematics may differ among players based on their own individual abilities and such variability would not be feasible for practice. Particularly with the ITN assessment, a standardized and established (ITF, 2002) assessment system would

provide unbiased data for both players and coaches for analysis and strategy-making process in training and match situations.

In general, tennis players are stronger, taller, fitter and faster. Due to continued technological advancement, rackets are becoming increasingly efficient. More aggressive use of the body has led to more powerful tennis strokes which in turn has made the game faster and shorter time to react and to make decisions. All of these factors have had a significant impact on the way the modern game is played and the characteristics of advanced modern tactics can be best summarized as follows as stated by Crespo and Reid (2002):

a. **Power used as a tactical weapon**: Power is being increasingly referred to as the name of the game. Cannon ball serves, attacking returns, killer forehands, winning approach shots and drive volleys are common among today‟s game.
b. **Faster decision making**: Tennis players need to decide what to do with the ball in less time. The options available are determined by the knowledge and the skill of the tennis player as well as the characteristics of the situation and the opponent.
c. **Use of best shots**: Usually the serve and the forehand. Tennis players generally base their game around these two strengths although the backhand is also being used very aggressively by a growing number of tennis players.
d. **Lack of specialist game styles**: Tennis players compete on various surfaces and in various conditions year round. This obliges them to develop more of an "all round" game.

The analysis of tennis tactics is one of the least developed disciplines of analysis. According to Sanz and Terroba (2012), the systems that analyze tennis tactics can be divided into two main categories, direct, which are applied during the game situation,

and indirect, the ones that are obtained after the analysis of the actions recorded in audio-visual systems. In both cases, observational methodology as a method to record and analyze is one of the main pillars of the process. As Sanz and Terroba (2012) had pointed out earlier that observation is a process that provides measurable and quantifiable information about what is being evaluated. Observation must be objective, using techniques that provide information for diagnosis and intervention. Usually, the observation depends on the coach´s vision of what he intends to study that is, the "clinical eye" of the coach (Sanz & Terroba, 2012). This system has a very important intrinsic value given the knowledge of the coach about the situations that need to be evaluated and analyzed. In most studies, it is the observational methodology that will provide the background to design investigations and analysis.

The T.A.C.T.I.C. theoretical framework for analyzing tactics in games is based on five components of play (Hopper & Bell, 1999). The five components are broken into two groups, the initial components and the advanced components. The initial components contain three aspects:

a. Space: Where an object should be placed in the area of play and where a player should go in the area of play.
b. Time: When to execute a skill within a game, when to create time to play a shot.
c. Force: How much and where to apply force on an object for height, directional control and distance.

While the advanced components that focus on the relationships between opponents are:

a. Self: In relation to what you are able to do with the initial components what should you do to gain a tactical advantage over your opponent?

b. Other: In relation to what the other player is doing with the initial components what should you do to gain a tactical advantage?

These components create in the players‟ minds the infinite possibilities of play within a game structure against similarly astute and agile opponents. Coaches who are using a movement approach have used these components to get young children to experiment and explore as the children learned to control objects in the environment set by the coach. The spatial component is foundational to tactical awareness. The advanced components add the relationship aspect of tactical play. Opponents who can use space, force and time to affect their play create an unpredictability that keeps the outcome of play uncertain as they observe the ability of their opponents. This relationship focus is fundamental to making a game play.

One of the principles outlined within a tennis research is that the winner of a tennis match is not always the tennis player with the better strokes. Tennis players should be intelligent enough to use a game plan that capitalizes on their strengths and the opponent‟s weaknesses. A study by Austin (1980) stated that the game strategy should be initiated during the warm up before the match. It is also stated that the best strategists are completely objective, they don‟t underrate the opponents nor overrate their own abilities. Several aspects are highlighted to help counter attack the opponent‟s strategy as stated by Austin (1980):

1. Develop a well-rounded game that will enable you to adjust to the opponent‟s strategy,

2. Exercise your intelligence and constantly analyze the situation, and

3. Assume good court position at all times. Playing percentage tennis is another tactical option that can be very effective.

Modern tennis tactics are continually evolving (Crespo & Reid, 2002) and the coach must develop a player to be tactically smart in order to have success at any level. Study by Hughes & Tillin (1995) showed that:

1. Elite players analyzed, displayed greater attacking strategies at the beginning and end of the games,
2. Their play became more attacking as each match progressed,
3. There are definite tactical patterns adopted by these players at critical points in each game and each set.

Tennis tactics means devising a realistic game plan which forces a player to evaluate the opponent‟s game and to learn how to scout and play the right game against the opponent.

2.6.4 Previous Studies Related to International Tennis Number (ITN)

A study was conducted by Sogut (2016) to determine the possible relations between serve speed and tennis skill level among junior tennis players where tennis skill level was assessed by means of International Tennis Number (ITN) on-court assessment protocol. Results revealed significant correlation between serve speed and International Tennis Number (ITN) in both male and female participants. Bayram, Cerrah, Simsek and Ertan (2016) investigated the effect of Whole Body Vibration (WBV) training on some tennis performance parameters including International Tennis Number (ITN) where the results revealed that there was a significant difference in some of the selected performance parameters.

Olcucu and Vatansever (2015) did a study to determine the anthropometric, body composition, physical, fitness parameters and ITN scores and levels among children tennis players and to define the relationships between these anthropometric, body

composition, physical fitness parameters and ITN scores and levels. They conducted the study on 30 female children tennis players between eight to ten years of age. The subjects were tested on four different performance variables, namely, the anthropometric, body composition, physical fitness and ITN levels profiles. For data analysis, the Pearson coefficient was calculated. According to the research findings, there are no significant relationships between ITN total scores and any of the anthropometric and body composition values. On the other hand, there are significant positive relationships between ITN total scores and ball throwing, vertical jumps, standing broad jumps and reverse sit-ups. There is a negative significant relation between ITN total scores and auditory reactions. Similarly, there are no significant relationships between ITN values and any of the anthropometric and body composition values. There are negative significant relationships between ITN values and ball throwing, vertical jumps, standing broad jumps, and reverse sit-ups. There is a positive significant relation between ITN values and auditory reactions. In conclusion, this study indicated that ball throwing, vertical jumps, standing broad jumps and back extension variables were statistically linked to specific performance levels identified via the ITN levels.

Mulazimoglu, Yanar, Celikbilek, Kizilkaya and Cetin (2015) examined players‟ forehand and backhand groundstrokes which are the most frequently used basic technical skills during a tennis match and tested the relationships between these shot at different levels of fatigue. The Groundstroke Depth Assessment Test (GDAT), which is one of International Tennis Number (ITN) tests were used to measure forehand and backhand shot accuracy of athletes. There were significant differences between GDAT scores of participants in terms of fatigue levels. However, there were no significant differences between shot test accuracy scores obtained in difference stress

periods. Söğüt, Kirazci and Korkusuz (2012) conducted a study to analyze the effects of rhythm training on tennis performance and rhythmic competence of tennis players, to compare the improvement levels of tennis specific and general rhythm training and to examine the effects of shorter and longer tempos on rhythmic competence. Thirty university students whose mean score of International Tennis Number (ITN) was 7.3 (±0.9) participated in this study and were divided randomly into three sub-groups: Tennis Group, General Rhythm Training Group and Tennis-Specific Rhythm Training Group. Even though the results showed that there were improvement in the groups after the 8 week intervention but no significant difference was found between the rhythm training groups.

Suna, Alp and Çetinkaya (2016) investigate the effects of technical training applied 10-12 age tennis players on their stroke performances. Trainings were applied to the players as technical 3 days a week and as condition 1 day a week. ITN tests (International Tennis Number) were applied to test the stroke performances. Differences were found to be statistically significant at result of comparing stroke performances" pre-tests and post-tests ($p<0,05$). This study shows the regular technical and conditional training's positive effects on performance and provides recommendations to trainers and sport scientists about planning, programming training and defining performance criteria. Kushwah (2014) evaluated the groundstrokes on depth, consistency and power during simulated tennis match progression on twelve trained university level male tennis players. Groundstrokes were analyzed through depth, consistency and power during the match. International tennis federation"s ground strokes depth and accuracy assessment (ITF Assessment Guide, 2004) was used to measure the performance. The results indicated that the consistency, depth and power was more in set 2 as compared to set 1

and set 3 ($p < 0.05$) as well as set 3 was the lowest as compared to set 1 ($p < 0.05$) in terms of consistency, power and depth.

2.7 Methodology of Training

In order to realize the proper training system and to achieve the desired performance excellence, all its factors - physical, psychological, technical and tactical skills must be performed at the highest parameters. Both training and competition are closely connected. Practically, training is inconceivable without competition. Preparation of athletes must meet fundamental training requirements for the training system with the integration of physical, psychological, technical and tactical factors in order to enhance and improve all processes.

A major shift in teaching methodology has been the catalyst of structuring the teaching and coaching process with the idea of adapting it to the match situation or game based approach, and thus emphasizing the role of strategy and tactics already in the initial stages of the game (Unierzyski & Crespo, 2007). The ability to perform a skill effectively is critical to performance, therefore, appropriate decisions or tactical approach concerning what to do in the game situation are equally important. Thus, the aim of the Tactical Approach to coaching tennis is to improve the overall game performance of the player combining tactical awareness and skill execution (Crespo & Cooke, 1999). The game approach emphasizes the use of games and mini-games to provide athletes with situations that are as close to a real match as possible (Launder, 2001).

This game situations training methodology appeared to be successful not only in tennis but also has found support among physical education practitioners in Europe and

the USA (Griffin, Mitchel & Oslin, 1997; Turner, 2001). Research by McPherson (1991), McPherson and French (1991) and Turner (2003) confirmed that because of tactical and game based approach tennis players demonstrate better game performance (shot precision and decision making) and have higher level of specific knowledge than players coached according to traditional approach. A sound background of technical and tactical training prepares athletes for match situations. Even though transferring skills from practice to matches can be difficult but by incorporating match-like situations into daily training, however, increases the likelihood that players will transfer skills from practices to matches (Martens, 2004).

Bunker & Thorpe (1982) developed the original "Games For Understanding" model as alternative to the traditional approach predominantly used in coaching and teaching in physical education (Werner, Thorpe & Bunker, 1996). Thorpe, Bunker, and Almond (1986) consider it necessary and indispensable to have a good understanding of the game, to know its fundamentals and, in order to improve, it is important to put tactics before technique. They state that: "It is necessary to develop a tactical awareness and decision making process in the students, always anticipating the technical execution factors, that is to say, technique must be subject to tactics." If coaches can apply a training methodology that is based on the real game situation, it will help the players to have the skill that will facilitate the transfer to the real game. Bunker and Thorpe (1986), who center sport teaching on understanding the nature of the game, and on the decision making process, consider that understanding and knowing the game, together with tactics, must precede technique.

Elderton (2008) suggests situation training with a playful perspective at all times while Stojan (1988) states that training is nothing but the simulation of the atmosphere

of a real match. On the other hand, Schonborn (2002) indicates that training must always be as similar to competition as possible. Likewise, Budó (2009) highlights the importance of a totally globalized practice that takes the training situations as close as possible to the real situations of the game.

According to Elderton (2008), the foundation of playing any game is tactical. It employs the relationships between the player, an opponent(s), and the elements of the game (e.g. a ball, the court). By using situations as building blocks in training, coaches will put together all the elements of tennis. Coaches can incorporate all these elements by placing them in a situational framework and therefore technical coaching in this framework becomes relevant and practical. Through this structured situation training, players may find that transferring practice skills to real match play will be easier.

In the game of tennis, the training methodology is based on assumption that at any given moment the player must be in one of 5 game situations which are serving, receiving, playing at the back of their own court with the opponent at the back of their court, approaching or at the net, playing at the back of the court with the opponent approaching or at the net (Unierzyski & Crespo, 2007). In each of these situations players perform certain tactics such as keep the ball in play, try to move the opponent around or use own strengths (Tennant, 2004). In this game situation, players are working on two things at the same time - they are in particular game situation and they are in a basic tactical situation. Therefore, the goal of coaching process in all modern methods is to teach players how to deal in these 5 game situations.

2.8 Summary

Performance analysis appears to be a method that is particularly useful for aiding in the design of specific training programs. It develops awareness for coaches, parents and players by identifying the strengths and weaknesses of one‟s abilities. Players would be able to identify their latest performance level and whether they have accomplished their set targets or goals. It will be the basis for goal setting and an ongoing process of evaluation. Completing the performance analysis effectively can offer athletes the opportunity to work with coaches to design a goal setting program in order to enhance sport performance. The central involvement of the athlete in the process is a key factor that may boost up motivation and encourage adherence to any intervention strategies designed. It may also improve the coach and athlete relationship by promoting information flow between them and addressing any perceived discrepancies. Additionally, the performance analysis can be used as a tool to assess the effectiveness of any interventions and highlight areas of good and poor performance progress. Completing the performance analysis effectively can assist the athletes to enhance their performance and achieve future success.

Although tennis is one of the most popular sports worldwide, few extensive reviews have been completed to help to provide tennis scientists, coaches, and players with a summary of the tennis research. This information may aid in the development of training programs designed to improve the performance. Among the major qualities that were noted existed are technical execution and tactical awareness and decision making. With the rapid development of modern tennis, technical and tactical abilities are moving in an extensive direction of training. In order to realize the potential, training must be performed at the highest parameters so that the desired performance excellent can be achieved.

By using a tactical based situation training framework, coaches can ensure their training and planning harmonizes with the Game-Based Approach. More importantly, they will be more effective at helping players training to play better tennis and improve their performance in competitions. A tennis player who is gifted in most important tennis-related components of performance can reach world-class standard with quality coaching, sufficient training and good tournament exposures. However, a player lacking in talent and ability in some of the above-mentioned skills can never be of world-class tennis standard, even by putting in extra hours of the training with an expert coach. The key is to realistically assess the potential and then set realistic goals which when achieved will give the satisfaction and confidence to pursue to a higher level. World-class tennis players are developed through proper stages, meticulous efforts, detailed training programs and long term planning. Therefore, the training process should be primarily focused on how the players will be able to manage and react to actual game situations. Thus, the training programs should include methods that emphasize to the ability of the players to take effective decisions and be competitive.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This study focused on exploring the performance of Malaysian junior tennis players and the effective training program that can have a significant impact on tennis development in Malaysia. Furthermore, this study went into details of finding the effects of an intervention on the technical and tactical performance of the players. The outcome of this study can be used by tennis associations, coaches and parents in monitoring and observing the progress of the junior tennis players. Besides monitoring the progress of players‟ performance, the performance profile would enable users to justify and to assess the effectiveness of existing training programs. There are many aspects that contribute significantly in tennis training, including a game based approach which plays a vital role and a major component in tennis training. This study utilized methods correlated with selection of subjects, selection of variables, experimental design, criteria measurements, administration of training program, data collection and treatments of the collected data.

3.2 Selection of Participants

The participants for this study were selected by using the purposive sampling method where all the participants were the top tennis players in Malaysia between the ages ranged from 12 to 16 years old and were ranked in the National Junior Ranking System. The ranking system was based on the accumulated points collected by the players in various national level tennis tournaments. The points collected determine the ranking achievement of each of the players who participated in the national tennis tournaments. Purposive sampling allows the researcher to pick the research participants who are likely to have the knowledge necessary to address the study purpose (Botma et al.,

2010). This type of sampling was chosen because pre-determined criteria were used to find participants that would be able to provide information about themselves and their circumstances to assist the researcher achieve the objectives of the study.

The participants were selected from Kuala Lumpur and Selangor because it is convenient to access and to monitor the training programs participated by them. The selection of the participants from these 2 states was also to facilitate possible gathering of the subjects at National Tennis Centre for testing procedures. All testing and training methods were explained to all the participants and consent forms were obtained from each of the participants. A total of thirty junior tennis players (n=30) were selected from Selangor and Kuala Lumpur which consisted of players from the age of 12 years old to 16 years old. The population size is an important factor in sample size (Cohen, Manion & Morrison, 2000; Lodico, Spaulding & Voegtle, 2006). Cochran (1977) and Krejcie & Morgan (1970) prepared tables which present the sample size in line with a certain degree of reliability and population size. Based on these tables, many researchers such as Yildirim & Simsek, (2006), Ross (2004) and Baykul (1999) suggest that if parametric tests are to be employed 30-500 subjects would be the necessary sample size.

An online sample size calculator for difference of means comparing two independent samples was used to calculate sample size (Sylvia & Terhaar, 2014). For a two tailed test, the value of alpha was set at 0.5 and desired power was 0.80. Based on these measures, the approximate sample size needed for this crossed over trial study to demonstrate sufficient power was 30. Since the sample size requirement for independent is larger than for repeated measures for the same subject, this sample size was more than adequate to provide adequate power in this study.

Sample size calculation was also conducted based on changes in the Movement Assessment Battery for Children (MABC-2) (Henderson, Sugen, & Barnett, 2007). The number of participants required in each group to produce a statistically meaningful change was calculated using the comparison of means in two independent groups (Daly & Bourke, 2000). The value for the standard deviation (σ), 4.5 was obtained from a study conducted by Piek, Dworcan, Barrett and Coleman (2000). The clinically significant change in the MABC-2 of five points was obtained from a study by Niemeijer, Smits-Engelsman and Schoemaker (2007). The value of the constant value „K", 7.8, was dictated by the significance level chosen for this study, in this case a two-sided significance level of 5% with an 80% chance of detecting a treatment effect. From the calculation demonstrated below, 26 participants were required to sufficiently power the study. A sample calculation revealed a target of two participants for each group was identified to accommodate a 20% drop-out rate (Hudson, 2009). Due to the process of block randomisation in groups of 15, a target sample size of 30 participants was set.

$$n > \frac{2K\sigma^2}{d^2}$$

$$\frac{2(7.8 \text{ for 2 sided test with significant level set at 0.05})(4.5)^2}{(5)^2}$$

12.6 (13 participants per group)

Total sample size which include 20% drop-out rate is 30.

These participants were then divided into 2 groups using randomized stratified sampling method into Experimental group and Control group. Each group consists of fifteen players (n=15). All participants had no history of chronic injuries and had participated in the competitive tennis at least 2 years before this study was initiated. None of the participants was involved in any other sports or training program during the course of this study.

3.3 Procedure and Design of Study

This research was conducted to explore the performance of Malaysian elite junior tennis players and to investigate the effects of Easy Five or five game situations training intervention and tennis match play on technical and tactical performance of the players. This study is a "one-within + one-between" design (experimental study with a control group) (Haag, 2004). Figure 3.1 shows the Research Framework of this study.

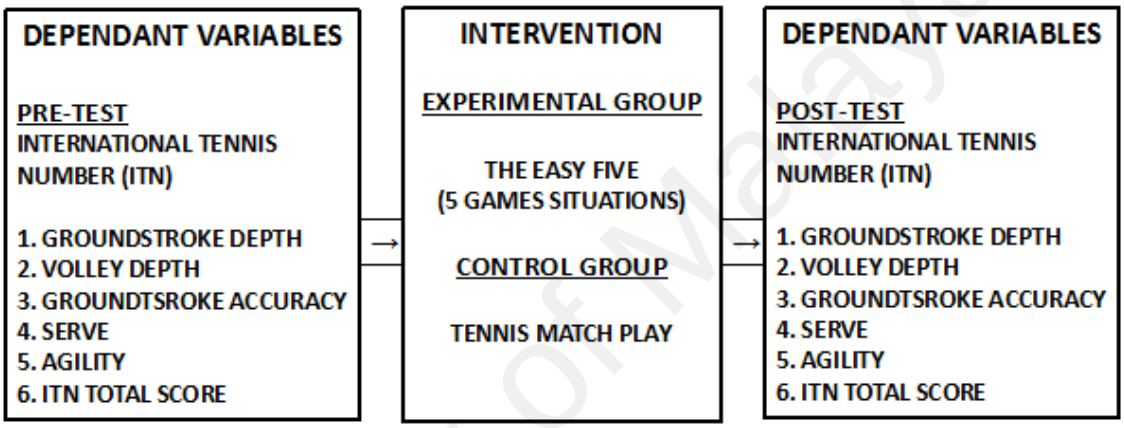

Figure 3.1: Research Framework

3.3.1 Procedure

Eight weeks of tennis training intervention were given to the participants. The eight weeks of study was based on previous studies that use eight weeks of intervention to conduct their research (Esfahani, Rahnama & Langerodi, 2014; Sahan & Erman, 2009; Sogut, Kirazci & Korkusiz, 2012; Zetou et al., 2014). Before the 8 weeks intervention, all players underwent a two-day assessment for pre-test. The experimental test sessions were conducted using the International Tennis Number (ITN) On-court Assessment for the assessment of technical and tactical performance.

The Experimental group received the Easy Five or Five Game Situations training program during the eight weeks intervention while Control group underwent tennis

match play within the same time period. After eight weeks, both groups had undergone the International Tennis Number (ITN) On-court Assessment. The real effects of the intervention were evaluated by comparing the change of performance in the Experimental group with the change of performance in the Control group.

3.3.2 Collection of Data: Pre-test and Post-test

For the purpose of profiling the players‟ performance, all participants were tested on the International Tennis Number (ITN) On-court Assessment in the pre-test. Each of the performance variables were assessed using scoring methodology as stated in the next section of this chapter. In the post-test, the participants were again tested with International Tennis Number (ITN) On-court Assessment to measure the Groundstroke Depth, Volley Depth, Groundstroke Accuracy, Serve, Agility and ITN total score. These methods correlate with the objectives of this study which focuses on the effects of an intervention program on the technical and tactical tennis performance of the participants.

3.3.3 Intervention Program: The Easy Five (Crespo, 2000)

The experimental group was inducted into an intervention based on Five Game Situations or known as the Easy Five (Crespo, 2000) which was employed for eight weeks with three sessions every week. At the same time, the control group of this study did not participate in any specific form of training but was engaged in tennis match play. Both experimental and control groups were tested on their technical and tactical performance before the intervention and the performance variables were retested upon the completion of the eight weeks intervention training program. The eight week intervention was applied based on few previous studies that have been conducted using

ITN as measurement tool by Fernandez-Fernandez et al. (2009); Sogut, Kirazci & Korkusuz (2012) and Soyleyci (2011).

3.3.4 Testers Reliability

The data collection exercise for this study was assisted by a national coach who is Level 2 International Tennis Federation (ITF) certified coach and was attached to the National Tennis Association. The national coach was assisted by two coaches from Selangor Tennis Association who are ITF Level 2 certified. All coaches were thoroughly briefed and were well aware of the administration of the tests and observation of all the tennis performance components.

3.4 Research Variables

The International Tennis Number (ITN) On-court Assessment is an objective on court tennis performance assessment which based on tennis specific tasks such as consistency, accuracy and power. It represents the tennis player‟s general level of play and it was used to determine the tennis playing level of the participants in this study. Under this system, players are rated from ITN 1 to ITN 10. ITN 1 represents a high level play and ITN 10 is a player that is starting to play competitively (can serve and return) on a full court using a normal ITF approved ball. The ITN has been approved by the International Tennis Federation (ITF) Coaches Commission and the ITF International Tennis Rating Taskforce (Crespo, Reid & Miley, 2003). ITN was originally developed to provide players with a benchmark that enables players to assess their tennis level with other players around the world. The ITN assessment was performed on court following the guidelines provided by the International Tennis Federation. (www.internationaltennisnumber.com). A ball machine manufactured by

Tennis Tower, Professional Model, Sports Tutor Inc. was utilized to feed and to quantify ball velocities during the ITN tests. All tests were conducted on two outdoor hard courts and were played according to the rules of the International Tennis Federation (ITF).

The participants performed 42 tennis strokes in total by applying their basic technical skills namely forehand, backhand, volley and serve. The performance variables tested in the International Tennis Number (ITN) On-Court Assessment include Groundstroke Depth, Volley Depth, Groundstroke Accuracy, Serve and Agility. Each of these performance variables provide points based on the performance of the participants in the test and total accumulated points from each of these performance variables will determine the participants" general playing level in the form of ITN total score.

3.5 Methods Used for the Performance Assessment Procedure

In order to facilitate the rating of the players, the ITF has developed a Description of Standards and an objective On-Court Assessment which both can be used to rate the players in the absence of competition results. The "ITN Description of Standards" describes each of the ten rating categories. The ITN On-court Assessment is made up of 5 sections:

a. Groundstroke depth assessment (10 alternate forehand and backhand groundstroke),

b. Groundstroke accuracy assessment (6 alternate forehand and backhand down the line and 6 alternate forehand and backhand cross court),

c. Volley Depth assessment (8 alternate forehand and backhand volleys),

d. Serving accuracy assessment (12 serves in total, 3 serves in each target area)

e. Agility test (Spider run test)

The assessment measures the subject‟s accuracy on power consistency and agility and the total score achieved corresponded to an ITN. The Spider run test which is included within ITN test was used to evaluate the participants‟ agility performances. This assessment measures the time it takes a player to pick five tennis balls and return them individually to a specific zone (Crespo, Reid & Miley, 2003).

3.5.1 Equipment

The ITN Assessment equipment is contained in the Assessment Kit which contains:

• 2 x 27' (8.23m) Depth lines. • 1 x Score sheet pad and pen.

• 1 x 48' (14.63m) Bonus line. • Stop Watch

• 2 x 39' (11.88m) Accuracy lines. • Basket of Balls.

3.5.2 Procedure

(Refer to Appendix B)

a. Depth measurements including strength measurements for ground strokes (A total of 10 strokes including 5 forehands and 5 backhands respectively).

b. Accuracy measurements including strength measurements for ground strokes (A total of 6 strokes; 3 forehand parallel, 3 backhand parallel and 6 strokes; 3 forehand cross. 3 backhand cross respectively).

c. Depth measurements including strength measurements for volley strokes (A total of 8 strokes, including 4 forehands and 4 backhands respectively).

d. Serve including strength measurements (A total of 12 serves, 3 serves to each target area)

e. Mobility (agility measurement) test.

3.5.3 Scoring

(Refer to Appendix B)

a. Scoring For Accuracy

The awarded scores for each shot were based on where the ball landed within the singles court.

b. Scoring for Power

1 Bonus point is awarded when the second bounce lands between the baseline and the Bonus Line. Double points are awarded when the second bounce lands beyond the Bonus Line.

c. Scoring for Consistency

1 extra point is awarded for every shot that is not an error.

Overall Scores

Maximum Scores

i. Depth Tests on the Groundstrokes	90 points.
ii. Accuracy and Strength Test on the Groundstrokes	84 points.
iii. Depth Tests on the Volley Strokes	72 points.
iv. Test of Serve Strokes	108 points.
v. Agility Test	76 points.
Total overall score	430 points.

d. Agility using Spider run test.

The test was conducted according to the procedure reported by Crespo, Reid & Miley (2003). The test is set up as shown in Figure 3.2.

d.1 Equipment required:

Tennis court, tennis balls, rackets, stopwatch and whistle.

d.2 Procedure:

The spider test was used to assess the specific agility performance for tennis players, in which 5 balls were placed on a racket on the baseline at the center mark. The subjects were required to place the balls to the indicated sideline or baseline as fast as possible. The subjects started at the center mark and ran with the first ball to the sideline/baseline intersection and returned for the second ball. The subjects placed the second ball on the intersection of the service line and singles sideline, the third ball on the intersection of the service line and center service line, the fourth ball on the intersection of the opposite service line and single sideline, and the fifth ball on the intersection of the single sideline and baseline. The subjects were required to perform 3 sets of the agility test with a 4-minute rest between sets. The minimum time (seconds) of these values was recorded.

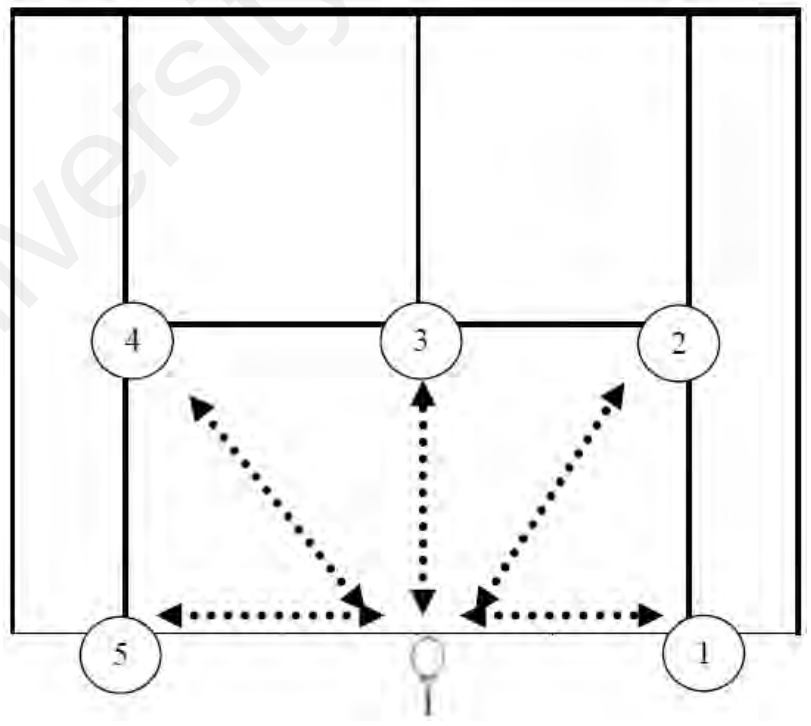

Figure 3.2 Spider Run Test (Crespo, Reid & Miley, 2003)

d.3 Scoring:

The player gets three chances, with the faster time taken and recorded in seconds for statistical analysis. The results recorded were compared to the norms of spider run test by United States Tennis Association (USTA) as shown in Appendix E (Kovacs, Roetert & Ellenbecker, 2016). The time recorded was converted into Mobility score based on the Mobility table that was provided in the ITN On-Court Assessment form in order to achieve the ITN total score. (Refer to Appendix D)

3.6 Training Intervention

The training intervention program based on Five Game Situations or The Easy Five was conducted on the Experimental Group for a period of 8 weeks while the Control Group was engaged in tennis match play. The frequency of training was 3 days a week for the subjects to follow the training program with a minimum of 2 hours" duration in each session.

The following program was adopted for the development of various performance factors during the intervention.

Duration of training intervention:	8 weeks
Number of days per week:	3 days (Monday, Wednesday and Friday)
Number of hours per day:	2 hours (5.00pm to 7.00pm)

3.6.1 Training schedule

Both groups had the same tennis training schedule for eight weeks but at different venues. This is to avoid the influence of Hawthorne effect during the administration of this study. Each training session started with general and tennis specific warm-up and

continued with practicing basic tennis strokes such as forehand and backhand groundstrokes where players hit the ball from baseline, forehand and backhand volleys including overhead shots where one player hits from baseline and the other player volleys at the net and serve where players took turn to serve and return. The warm-up sessions lasted for 30 minutes.

3.6.1.1 Easy Five Training by Experimental group

After the warm-up and basic practice, the Experimental group engaged into the Easy Five training as below;

* Serve and return drills. Players play points and work on tactical patterns of play to win points. (30 minutes)

* Forehand and Backhand Groundstrokes Baseline drills. Players play points and work on tactical patterns of play to win points (30 minutes)

* Approach shots, volleys and passing shots drills. Players play points and work on tactical patterns of play to win points at the net or when opponents attack and come to the net (30 minutes)

(Refer to Appendix F)

3.6.1.2 Tennis Match Play by Control group

After the warm-up and basic practice, the Control group engaged into tennis match play by playing normal best of three sets. The matches were set by coaches with each player has to play against a different player in every training session. The players counted the score on their own and reported the results to the coaches. Player who won the most matches was awarded an incentive set by coaches. This was to ensure that the players give their best efforts in the tennis match play.

3.7 Statistical Analysis

The study aims to explore the players‟ technical and tactical performance components as well as to investigate the significant difference in the performance of Groundstroke Depth, Volley Depth, Groundstroke Accuracy, Serve, Agility and ITN total score after 8 weeks of intervention. Mean scores and standard deviation were calculated for each variable. A mixed between-within subject analysis known as split-plot ANOVA (SPANOVA). The statistical techniques provide the comparison of the two groups over time. An interaction effect between the performance level and measurement reveals differences between the experimental group and control group that changed as a function of time. An alpha of 0.05 will be adopted for all the tests of significance.

3.8. Exploratory Data Analysis

The basic objectives in data analysis were to answer the research questions; primarily this research was seeking to find out if there are any effects of Easy Five or Five Game Situation training programs on the performance of Malaysia elite junior tennis players. Statistical Package for Social Sciences (SPSS Version 23.0) and Microsoft Excel software have been used in order to analyze the data in this study. There are three important parts in data analysis which are exploration of data, descriptive statistics and inferential statistics. The exploratory data analysis (EDA) was conducted with the purpose of screening the normality of the data distribution and descriptive statistics on technical and tactical attributes of all the junior tennis players. Mixed ANOVA was conducted between pre-test and post-test of International Tennis Number (ITN) scores for the experimental group and control group to analyze for possible differences after the intervention of 8 weeks.

CHAPTER 4: DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter discusses the data analysis and findings of the research to investigate the effects of an intervention training program on the performance of Malaysian elite junior tennis players aged between 12 years to 16 years old. The analysis and discussion are organized in the following manner; section 4.1 presents the introduction of chapter 4. Next section 4.2 discusses the exploration of data including descriptive and normality analysis. Section 4.3 presents the demographic profile of junior tennis players. Section 4.4 and 4.5 reports the findings based on the research questions and objectives of the study. The final section is the summary of this chapter.

4.2 Exploration of Data

The exploratory data analysis (EDA) was conducted with the purpose of screening the normality of the data distribution and descriptive statistics on technical and tactical profile attributes of all the junior tennis players. Mixed ANOVA was conducted between pre-test and post-test of International Tennis Number (ITN) scores for the experimental group and control group to analyze for possible differences after the intervention of 8 weeks. The results of this study were analyzed using the Statistical Package Social Sciences (SPSS) 23.0. Statistical significance was defined as $p < 0.05$.

4.3 Demographic Profile

The objectives of this study were to investigate the effects of an intervention training programs on the performance of Malaysian elite junior tennis players, age of 12 years to 16 years old. Descriptive statistics on the results of the analysis of data and

interpretations were made on all the participants (n=30) before they were divided into 2 groups;

a. Experimental Group.

b. Control Group.

Both groups experienced the same testing procedure but different intervention programs as explained in Chapter 3. Descriptive data for demographic profile as follow:

Table 4.1: Descriptive analysis results for Experimental group and Control group

Group	Frequency	Percentage
Experimental Group	15	50.00
Control Group	15	50.00

Table 4.1 represents the balance distribution of respondents consist of 15 players from experimental group and 15 players from control group which made up a total of 100% of total respondents.

Table 4.2: Demographic Profile of Experimental Group and Control Group

Demographic	Experimental Group (N=15)		Control Group (N=15)	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Age				
12	3	20.00	3	20.00
13	2	13.33	3	20.00
14	3	20.00	2	13.33
15	2	13.33	3	20.00
16	5	33.33	4	26.67
Ranking				
1	2	13.33	-	-
2	2	13.33	-	-
3	3	20.00	3	20.00
4	2	13.33	4	26.67
5	3	20.00	2	13.33
6	1	6.67	2	13.33
7	2	13.33	2	13.33
8	-	-	2	13.33
Game Style				
Counter Puncher	3	20.00	3	20.00
Baseliner	11	73.33	10	66.66
Net Rusher	-	-	1	6.67
Serve & Volleyer	1	6.67	1	6.67

Table 4.2 provides a detailed description on the demographic profiles of total participants between the experimental and control groups. In the ranking classification, experimental group consists of the representation of 1st to 7th ranking according to National Ranking Age Category, meanwhile, the control group represented from 3rd to 8th ranking according to National Ranking Age Category. For the game style, majority of the participants from the experimental and control groups were classified and were grouped as follows; baseliner, counter puncher, serve & volleyer and net rusher. The

results show that majority of the participants for both groups were baseliners with 73.33% for Experimental group and 66.66% for Control group.

4.4 Descriptive statistics on Technical and Tactical Performance

Table 4.3: Descriptive parameters for all participants (N=30)

Performance variables	Mean	Std. Deviation (± SD)
Groundstroke Depth	40.27	6.69
Volley Depth	29.97	5.83
Groundstroke Accuracy	40.53	4.69
Serve	48.60	8.80
Agility	18.09	1.42
ITN Total Points	241.67	40.13

Table 4.3 presented the participants‟ International Tennis Number (ITN) total score with mean = 241.67. Appendix C shows the Standard of Description of International Tennis Number (ITN) and indicates that the participants are at ITN 6 which is at intermediate level. The ITN Standard of Description describes tennis player rated at ITN 6 as player who exhibits more aggressive net play, has improved court coverage, improved shot control and is developing teamwork in doubles (Appendix C).

Table 4.4: Descriptive Statistics For Experimental and Control Group

Dependant Variables (DV)	Pre-test		Post-test	
	Experimental (n=15)	Control (n=15)	Experimental (n=15)	Control (n=15)
	Mean (± SD)	Mean (± SD)	Mean (± SD)	Mean (± SD)
Groundstroke Depth	49.13 (7.89)	46.60 (6.38)	54.80 (8.70)	46.73 (6.27)
Volley Depth	36.07 (7.32)	36.00 (5.44)	42.27 (4.68)	37.13 (4.22)
Groundstroke Accuracy	50.40 (5.26)	48.60 (5.07)	55.00 (5.86)	49.67 (3.27)
Serve	60.53 (11.23)	57.87 (8.52)	64.40 (11.72)	59.47 (8.18)
Agility	17.82 (1.49)	18.36 (1.34)	17.42 (1.55)	18.17 (1.35)
ITN Total Score	247.33 (40.31)	236.00 (30.12)	271.60 (41.45)	240.73 (26.82)

4.5 Normality Test

Data were analyzed to determine whether all the data were normally distributed and therefore it is capable to satisfy the parametric assumptions and to proceed with the Mixed ANOVA statistical analysis. The Shapiro-Wilk‟s test was used to determine whether the data were normally distributed and all variables showed a normal distribution except for Serve in the Experimental group (p values of Shapiro-Wilk‟s statistics ≥0.05). The results covered the pre-test of the International Tennis Number (ITN) components on the attribute profiles for both the experimental and control groups.

Table 4.5: Shapiro-Wilk's Test of Normality

		Shapiro-Wilk"s		
		Statistic	df	Sig.
Pre-test Groundstroke Depth	Control	0.92	15	0.21
	Experimental	0.92	15	0.17
Post-test Groundstroke Depth	Control	0.93	15	0.32
	Experimental	0.89	15	0.07
Pre-test Volley Depth	Control	0.97	15	0.90
	Experimental	0.95	15	0.56
Post-test Volley Depth	Control	0.94	15	0.38
	Experimental	0.89	15	0.08
Pre-test Groundstroke Accuracy	Control	0.95	15	0.52
	Experimental	0.95	15	0.57
Post-test Groundstroke Accuracy	Control	0.88	15	0.04
	Experimental	0.95	15	0.57
Pre-test Serve	Control	0.91	15	0.15
	Experimental	0.84	15	0.01
Post-test Serve	Control	0.93	15	0.31
	Experimental	0.91	15	0.13
Pre-test Agility	Control	0.89	15	0.06
	Experimental	0.91	15	0.12
Post-test Agility	Control	0.91	15	0.11
	Experimental	0.90	15	0.10
Pre-test ITN	Control	0.95	15	0.56
	Experimental	0.92	15	0.22
Post-test ITN	Control	0.96	15	0.72
	Experimental	0.90	15	0.11

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 4.5 shows the results of normality test for all dependent variables for both groups. All data showed normal distribution ($p > 0.05$) based on the results from Shapiro-Wilks‟ test with the exception of Groundstroke Accuracy for Control Group ($p = 0.04$) and Serve for Experimental group ($p = 0.01$). This abnormality will be addressed and further assessed for normality by using the Normal Q-Q plots distribution.

4.5.1 Normal Q-Q Plots for Assessing Normality

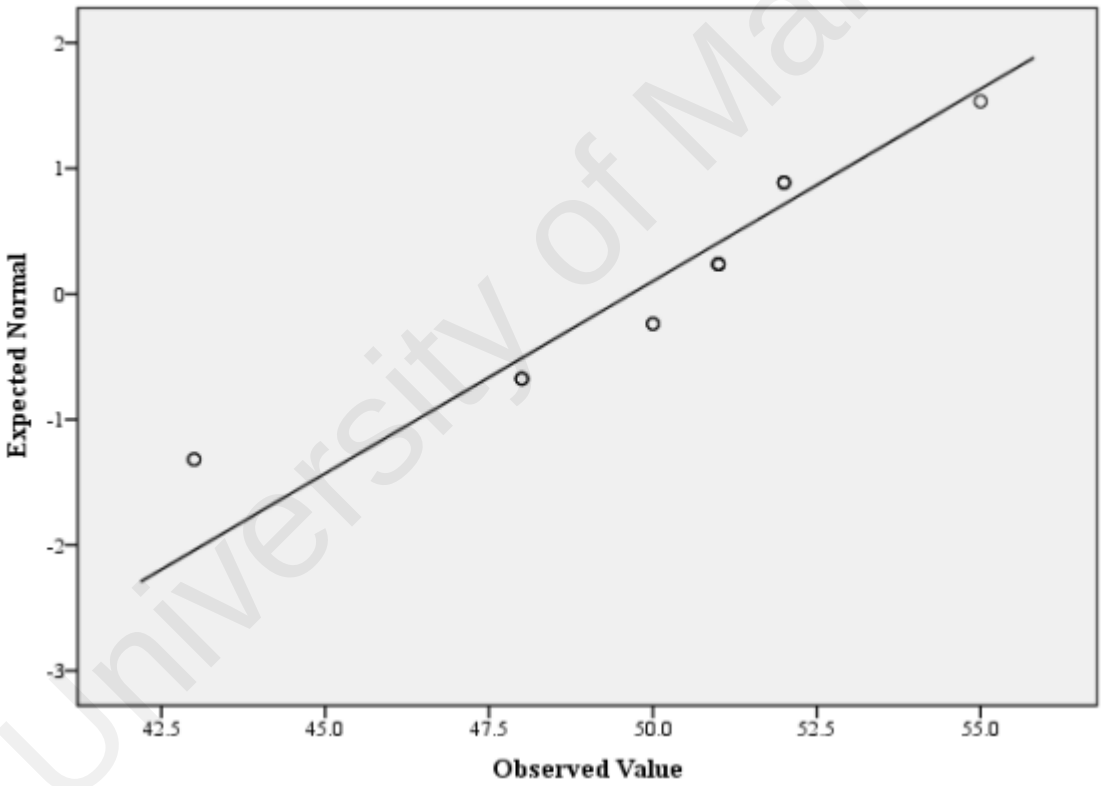

Figure 4.1: Normal Q-Q plot of post-test for Groundstroke Accuracy on Control group

Figure 4.1 indicates that the Normal Q-Q plots of the data for post-test of Groundstroke Accuracy on Control group shows a normal distribution of data in this dependent variable and therefore further analysis on the simple effects can be computed.

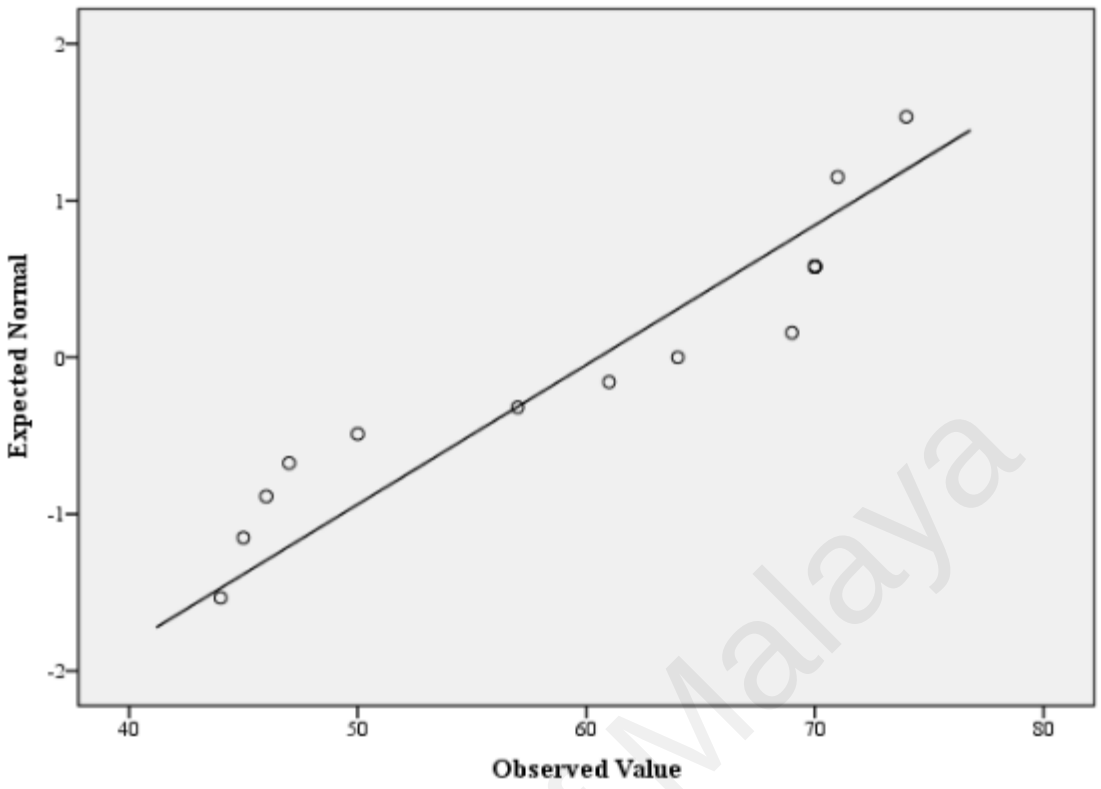

Figure 4.2: Normal Q-Q plot of pre-test for Serve on Experimental group

Figure 4.2 indicates that the Normal Q-Q plots of the data for pre-test of Serve on Experimental group shows a normal distribution of data in this dependent variable and therefore further analysis on the simple effects can be computed.

4.6 Testing the Research Questions

The objective of this study was to investigate the effects of an intervention training programs on the performance of Malaysian top junior tennis player‟s age between 12 years to 16 years old using the International Tennis Number (ITN) assessment method. In the earlier normality test, all variables were found to be normally distributed. The mixed ANOVA assumes that there are equal variances between the categories of the between-subjects factor, group, at each category of the within-subjects factor, time, for the dependent variables. If the variances are unequal, this can affect the Type I error

rate. Levene's test of equality of error variances tested the assumption of homogeneity of variances and the results of these tests are presented in the Levene's Test of Equality of Error Variances table.

A further assumption of the mixed ANOVA is that there is similar covariance. It can be tested with Box's test of equality of covariance matrices, which is presented in the Box's test of equality of covariance matrices table. The important row of the table is the "Sig." row, which represents the significance level (p-value) of the test. If this test is statistically significant ($p < 0.001$), it does not have equal covariance, but if the test is not statistically significant, it has equal covariance and the assumption of homogeneity of covariance was not violated. The statistical analyses on significance of the mean analysis for the ITN performance attributes profile are presented in table 4.6 till 4.31.

4.6.1 Split-Plots Analysis of Variance (SPANOVA) on Groundstroke Depth.

In order to ensure lower Type I error rate, the totals for the two groups were assessed for homogeneity of equal variances using Levene‟s Test of Equality of Error Variances prior to the test of Split-Plots Analysis of Variance (SPANOVA).

Table 4.6: Levene's Test of Equality of Error Variances[a] on Groundstroke Depth

	F	df1	df2	Sig.
Pre-test Groundstroke Depth	0.24	1	28	0.63
Post-test Groundstroke Depth	1.26	1	28	0.27

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Group
Within Subjects Design: Time

Table 4.6 above shows the Levene‟s Test of Equality of Error Variances for pre-test and post-test on Groundstroke Depth scores. Both pre-test and post-test Groundstroke Depth scores did not violate the assumption of homogeneity of variances ($p > 0.05$).

In order to determine if there was a significant difference between pre-test and post-test scores as a whole and to determine if there was a significant effect on the treatment for both groups, Multivariate Tests using Wilks‟ Lambda was administered and the results are as follows;

Table 4.7: Multivariate Tests using Wilks' Lambda on Groundstroke Depth

Effect	Value	F	Hypothesis df	Error df	Sig.
Time	0.69	12.59[b]	1	28	0.01
Time * Group	0.71	11.46[b]	1	28	0.01

a. Design: Intercept + Group
Within Subjects Design: Time
b. Exact statistic

Table 4.7 shows the macro-level analysis for Groundstroke Depth score using the Wilks‟ Lambda Multivariate test. There was a significant change in mean score from pre-test to post-test as a whole ($F_{1,28} = 12.59$; $p < 0.05$; $\eta^2 = 0.69$). There was indeed a significant interaction effect between the intervention period and the assigned group on Groundstroke Depth ($F_{1,28} = 11.46$; $p < 0.05$; $\eta^2 = 0.71$).

In order to determine if there was a significant difference in the performance of Groundstroke Depth by Experimental group and Control group, a Test of Within-Subjects Effects was conducted as below;

Table 4.8: Tests of Within-Subjects Effects on Groundstroke Depth

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	126.15	1	126.15	12.59	0.01	0.31
Time * Group	114.82	1	114.82	11.46	0.01	0.29
Error (Time)	280.53	28	10.02			

Table 4.8 shows that there is significant change overtime (pre-test and post-test) for Groundstroke Depth scores ($F_{1,28}$ = 12.59; p < 0.05), however, the significant interaction effect shows that the changes occurring overtime are highly dependent on the type of intervention assigned to the group ($F_{1,28}$ = 11.46; p < 0.05).

Pairwise Comparison was administered to determine the significant difference within the groups after 8 weeks of intervention. Table 4.9 displays the results of Pairwise Comparison within Experimental group and Control group on Groundstroke Depth performance.

Table 4.9: Pairwise Comparisons Within Groups on Groundstroke Depth

Group	Mean Difference (I-J)	Std. Error	Sig.[b]
Control	-0.13	1.16	0.91
Experimental	-5.67*	1.16	0.001

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4.9 shows the pairwise comparisons for the means of the Groundstroke Depth scores comparing the group changes overtime using Bonferroni method. The Control group showed no significant change in Groundstroke Depth scores at the end of the intervention (p = 0.91) while the experimental group showed significant improvements in Groundstroke Depth scores after their 8-week intervention (p = 0.001).

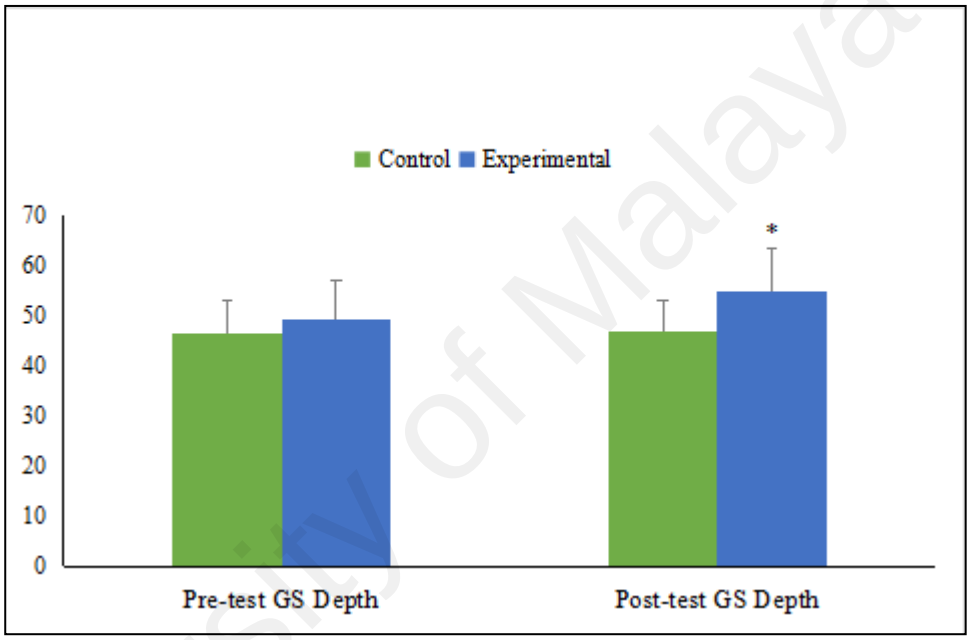

Figure 4.3: Estimated marginal means of pre-test and post-test by groups on Groundstroke Depth

Figure 4.3 shows the estimated marginal means for Groundstroke Depth scores at pre-test and post-test for both control and experimental groups. ("*" represents a significant change when compared between groups and over time). Experimental group has shown a significant improvement in Groundstroke Depth after the 8 weeks of Easy Five intervention as compared to the Control group who went through the tennis match during the 8 week of treatment.

The performance comparison in the Groundstroke Depth between Experimental group and Control group was administered and the results indicated that there is a significant difference in the performance of Experimental group but there is no significant difference in the performance of Control group after 8 weeks of treatment. Results from statistical analysis also indicated that there is a significant difference between Experimental group and Control group after participating in the 8 week training program ($F_{1,28} = 12.59$; $p < 0.05$). Wilks‟ Lambda indicated that there was a significant change in mean score from pre-test to post-test as a whole ($F_{1,28} = 12.59$; $p < 0.05$; $\eta^2 = 0.69$). There was indeed a significant interaction effect between the intervention period and the assigned group on Groundstroke Depth ($F_{1,28} = 11.46$; $p < 0.05$; $\eta^2 = 0.71$).

Results from the statistical analysis have shown that there is a significant difference in the performance of Experimental group in Groundstroke Depth after the 8 weeks of Easy Five or the Five Game Situations training program while the Control group who engaged in the tennis match did not show any significant difference in the performance of Groundstroke Depth. The result also indicated that there is a significant difference of performance in the Groundstroke Depth between the Experimental group and Control group after 8 weeks of treatment. These findings suggested that the Easy Five training program has significantly improved the Groundstroke Depth performance of the junior tennis players as compared to the tennis match.

4.6.2 Split-Plots Analysis of Variance (SPANOVA) on Volley Depth.

In order to ensure lower Type I error rate, the totals for the two groups are assessed for homogeneity of equal variances using Levene‟s Test of Equality of Error Variances.

Table 4.10: Levene's test of equality of error variances on Volley Depth

	F	df1	df2	Sig.
Pre-test Volley Depth	1.61	1	28	0.21
Post-test Volley Depth	1.12	1	28	0.30

Test the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Group
Within Subjects Design: Time

Table 4.10 shows the Levene"s Test of Equality of Error Variances for Pre-test and Post-test Volley Depth scores. Both Pre-test and Post-test Volley Depth scores did not violate the assumption of homogeneity of variances ($p > 0.05$).

In order to determine if there was a significant difference between pre-test and post-test scores as a whole and to determine if there was a significant effect on the treatment for both groups, Multivariate Tests using Wilks" Lambda was administered and the results are as follows;

Table 4.11: Multivariate Tests using Wilks' Lambda on Volley Depth

Effect	Value	F	Hypothesis df	Error df	Sig.
Time	0.49	29.55[b]	1	28	0.001
Time * Group	0.66	14.11[b]	1	28	0.01

a. Design: Intercept + Group
Within Subjects Design: Time

b. Exact statistic

Table 4.11 shows the macro-level analysis for Volley Depth scores. There was a significant change in mean scores from Pre-test to Post-test ($F_{1,28} = 29.55$; $p = 0.00$; $\eta^2 = 0.51$). There was indeed an interaction between the intervention period and the assigned group ($F_{1,28} = 14.11$; $p = 0.01$; $\eta^2 = 0.33$).

Table 4.12: Tests of Within-Subjects Effects on Volley Depth

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Time	201.67	1	201.67	29.55	0.001
Time * Group	96.27	1	96.27	14.11	0.01
Error (Time)	191.07	28	6.82		

Table 4.12 shows that there happened to be significant change overtime (pre-test and post-test) in Volley Depth scores ($F_{1,28} = 29.55$; $p = 0.001$; $\eta^2 = 0.51$), however, the significant interaction effect shows that the changes occurring overtime are highly dependent on the type of intervention assigned to the group ($F_{1,28} = 14.11$; $p = 0.01$; $\eta^2 = 0.33$).

Table 4.13: Pairwise Comparisons Within Groups on Volley Depth

Groups:	Mean Difference (I-J)	Std. Error	Sig.[b]
Control	-1.13	0.95	0.25
Experimental	-6.20*	0.95	0.001

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4.13 shows the pairwise comparisons for the means of Volley Depth scores comparing the group changes overtime using the Bonferroni method.. The control group showed no significant change in Volley Depth scores at the end of the intervention (p = 0.25) while the experimental group showed significant improvements in Volley Depth scores after their 8-week intervention (p = 0.001).

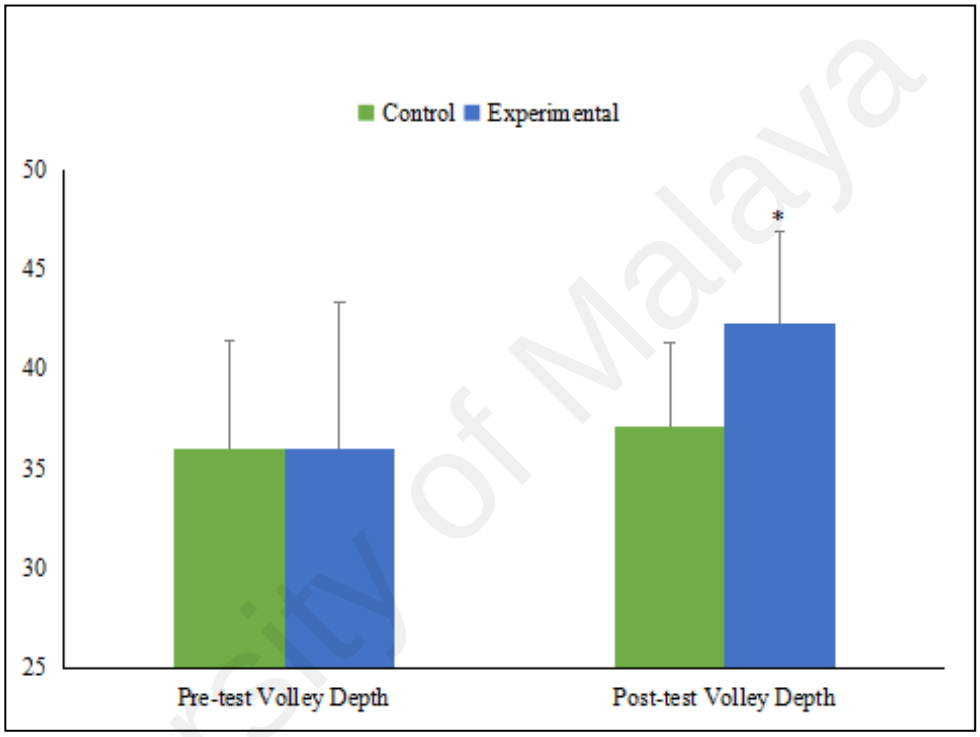

Figure 4.4: Estimated marginal means of pre-test and post-test by groups on Volley Depth

Figure 4.4 shows the estimated marginal means on Volley Depth scores at Pre-test and Post-test for both control and experimental groups. ("*" represents a significant change when compared between groups and over time). Experimental group has shown a significant improvement in the Volley Depth after the 8 weeks of Easy Five intervention program as compared to the control group.

The performance comparison in the Volley Depth between Experimental group and Control group was administered and the results indicated that there is a significant difference in the performance of Experimental group but there is no significant difference in the performance of Control group after 8 weeks of treatment.

Results from statistical analysis also indicated that there is a significant difference between Experimental group and Control group after participating in the 8 week training program ($F_{1,28} = 29.55$; $p < 0.05$). Wilks' Lambda indicated that there was a significant change in mean score from pre-test to post-test as a whole ($F_{1,28} = 29.55$; $p < 0.05$). There was indeed a significant interaction effect between the intervention period and the assigned group on Volley Depth ($F_{1,28} = 14.11$; $p < 0.05$).

Results from the statistical analysis have shown that there is a significant difference of performance of Experimental group in the Volley Depth after the 8 weeks of Easy Five of the Five Game Situations training programme while the Control group who engaged in the tennis match did not show any significant different in the performance of Volley Depth. The result also indicated that there is a significant different of performance in the Volley Depth between the Experimental group and Control group after 8 weeks of treatment. These results suggested that the Easy Five training programme has significantly improved the Volley Depth performance of the junior tennis players as compared to the tennis match.

4.6.3 Split-Plots Analysis of Variance (SPANOVA) on Groundstroke Accuracy.

In order to ensure lower Type I error rate, the totals for the two groups were assessed for homogeneity of equal variances using Levene‟s Test of Equality of Error Variances.

Table 4.14: Levene's Test of Equality of Error Variances[a] on Groundstroke Accuracy

	F	df1	df2	Sig.
Pre-test Groundstroke Accuracy	0.04	1	28	0.85
Post-test Groundstroke Accuracy	3.96	1	28	0.06

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Group
Within Subjects Design: Time

Table 4.14 above shows the Levene‟s Test of Equality of Error Variances for Pre-test and Post-test of Groundstroke Accuracy scores. Both Pre-test-and Post-test of Groundstroke Accuracy scores did not violate the assumption of homogeneity of variances ($p > 0.05$).

In order to determine if there was a significant difference between pre-test and post-test scores as a whole and to determine if there was a significant effect on the treatment for both groups, Multivariate Tests using Wilks‟ Lambda was administered and the results are as follows;

Table 4.15: Multivariate Tests using Wilks' Lambda on Groundstroke Accuracy

Effect	Value	F	Hypothesis df	Error df	Sig.
Time	0.65	15.23[b]	1	28	0.001
Time * Group	0.82	5.92[b]	1	28	0.02

a. Design: Intercept + Group
Within Subjects Design: Time

b. Exact statistic

Table 4.15 shows the macro-level analysis for Groundstroke Accuracy scores. There was a significant change in mean scores from Pre-test to Post-test ($F_{1,28} = 15.23$; $p < 0.05$). There was indeed an interaction between the intervention period and the assigned group ($F_{1,28} = 5.92$; $p < 0.05$).

Table 4.16: Tests of Within-Subjects Effects on Groundstroke Accuracy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Time	120.42	1	120.42	15.24	0.01
Time * Group	46.82	1	46.82	5.92	0.02
Error (Time)	221.27	28	7.90		

Table 4.16 shows that there happened to be significant change overtime (pre-test and post-test) in Groundstroke Accuracy scores ($F_{1,28} = 15.24$; p = 0.01), however, the significant interaction effect shows that the changes occurring overtime are highly dependent on the type of intervention assigned to the group ($F_{1,28} = 5.92$; p = 0.02).

Table 4.17: Pairwise Comparisons Within Groups on Groundstroke Accuracy

Groups:	Mean Difference (I-J)	Std. Error	Sig.[b]
Control	-1.07	1.03	0.31
Experimental	-4.60*	1.03	0.001

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4.17 shows the pairwise comparisons for the means of the Groundstroke Accuracy scores comparing the group changes overtime using the Bonferroni method. The Control group showed no significant change in Groundstroke Accuracy scores at the end of the intervention (p = 0.31) while the Experimental group showed significant improvements in Groundstroke Accuracy scores after their 8-week intervention (p = 0.001).

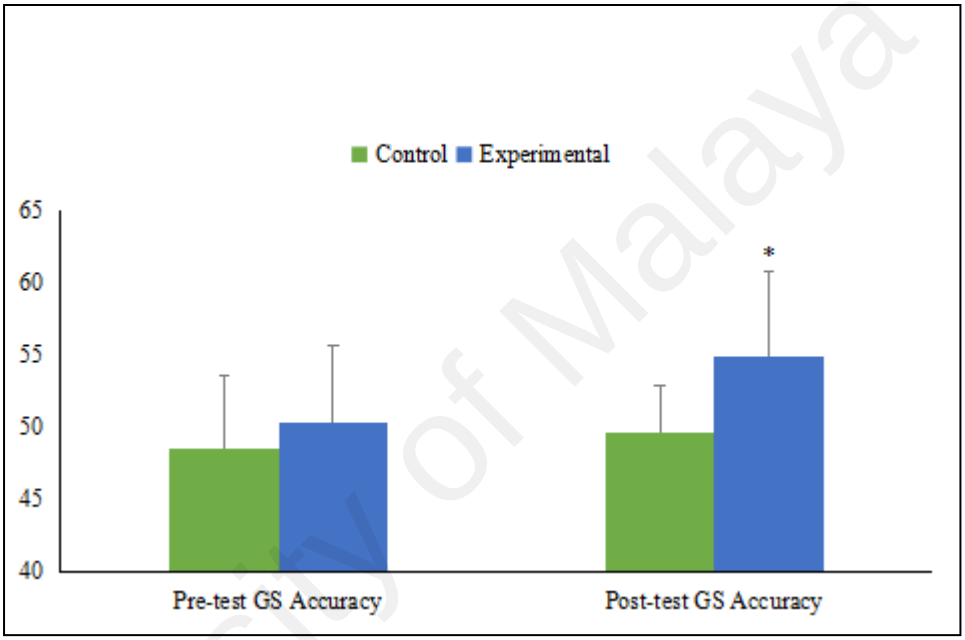

Figure 4.5: Estimated marginal means of pre-test and post-test by groups on Groundstroke Accuracy

Figure 4.5 shows the estimated marginal means for Groundstroke Accuracy scores at Pre-test and Post-test for both control and experimental groups. ("*" represents a significant change when compared between groups and over time). Experimental group has shown a significant improvement in Groundstroke Accuracy after the 8 weeks of Easy Five intervention as compared to the control group who went through the tennis match but did not make any significant improvement.

The performance comparison in the Groundstroke Accuracy between Experimental group and Control group was administered and the results indicated that there is a significant difference in the performance of Experimental group but there is no significant difference in the performance of Control group after 8 weeks of treatment.

Results from statistical analysis also indicated that there is a significant difference between Experimental group and Control group after participating in the 8 week training program ($F_{1,28} = 15.23$; $p < 0.05$). Wilks' Lambda indicated that there was a significant change in mean score from pre-test to post-test as a whole ($F_{1,28} = 12.59$; $p < 0.05$; $\eta^2 = 0.69$). There was indeed a significant interaction effect between the intervention period and the assigned group on Groundstroke Accuracy ($F_{1,28} = 5.92$; $p < 0.05$; $\eta^2 = 0.71$).

Results from the statistical analysis have shown that there is a significant difference of performance of Experimental group in the Groundstroke Accuracy after the 8 weeks of Easy Five or Five Game Situations training program while the Control group who engaged in the tennis match did not show any significant different in the performance of Groundstroke Accuracy. The result also indicated that there is a significant different of performance in the Groundstroke Accuracy between the Experimental group and Control group after 8 weeks of treatment. These results suggested that the Easy Five training program has significantly improved the Groundstroke Accuracy performance of the junior tennis players as compared to the tennis match.

4.6.4. Split-Plots Analysis of Variance (SPANOVA) For Serve.

In order to ensure lower Type I error rate, the totals for the two groups are assessed for homogeneity of equal variances using Levene"s Test of Equality of Error Variances.

Table 4.18: Levene's Test of Equality of Error Variances[a] on Serve

	F	df1	df2	Sig.
Pre-test Serve	2.71	1	28	0.11
Post-test Serve	2.01	1	28	0.17

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Group
Within Subjects Design: Time

Table 4.18 shows the Levene"s Test of Equality of Error Variances for Pre- and Post-test on Serve. Both Pre-test and Post-test of Serve scores did not violate the assumption of homogeneity of variances ($p > 0.05$).

Table 4.19: Multivariate Tests[a] using Pillai's Trace on Serve

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Time	0.26	9.91[b]	1	28	0.01	0.26
Time*Group	0.06	1.70[b]	1	28	0.20	0.06

a. Design: Intercept + Group
Within Subjects Design: Time

b. Exact statistic

Table 4.19 shows the macro-level analysis for Serve scores. There was a significant change in mean scores from Pre-test to Post-test ($F_{1,28}$ = 9.91; p = 0.01; η^2 = 0.26). There was no interaction between the intervention period and the assigned group ($F_{1,28}$ = 1.70; p = 0.20; η^2 = 0.05).

Table 4.20: Tests of Within-Subjects Effects on Serve

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	112.07	1	112.07	9.91	0.01	0.26
Time * Group	19.27	1	19.27	1.70	0.20	0.06
Error (Time)	316.67	28	11.31			

Table 4.20 shows that there happened to be significant change overtime (pre-test and post-test) in Serve scores ($F_{1,28}$ = 9.91; p = 0.01; η^2 = 0.26), however, no interaction effect proves that the changes that occurred over time happened regardless of the type of intervention assigned to the group ($F_{1,28}$ = 1.70; p = 0.20; η^2 = 0.06).

Table 4.21: Tests of Between-Subjects Effects on Serve

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	220099.27	1	220099.27	1157.52	0.00
Group	216.60	1	216.60	1.14	0.29
Error	5324.13	28	190.15		

Table 4.21 shows the tests of Between-Subjects Effects. The tests show that there was indeed no significant difference between the Experimental group and Control group mean scores for Serve (F = 1.14; $p = 0.29$; $\eta^2 = 0.04$).

Table 4.22: Pairwise Comparisons Within Groups on Serve

Groups:	Mean Difference (I-J)	Std. Error	Sig.[b]
Control	-1.60	1.23	0.20
Experimental	-3.87*	1.23	0.01

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4.22 shows the pairwise comparisons for the means of the Serve scores comparing the group changes overtime using the Bonferroni method. The control group showed no significant change in Serve scores at the end of the intervention ($p = 0.20$) while the experimental group showed significant improvements in Serve scores after their 8-week intervention ($p = 0.01$).

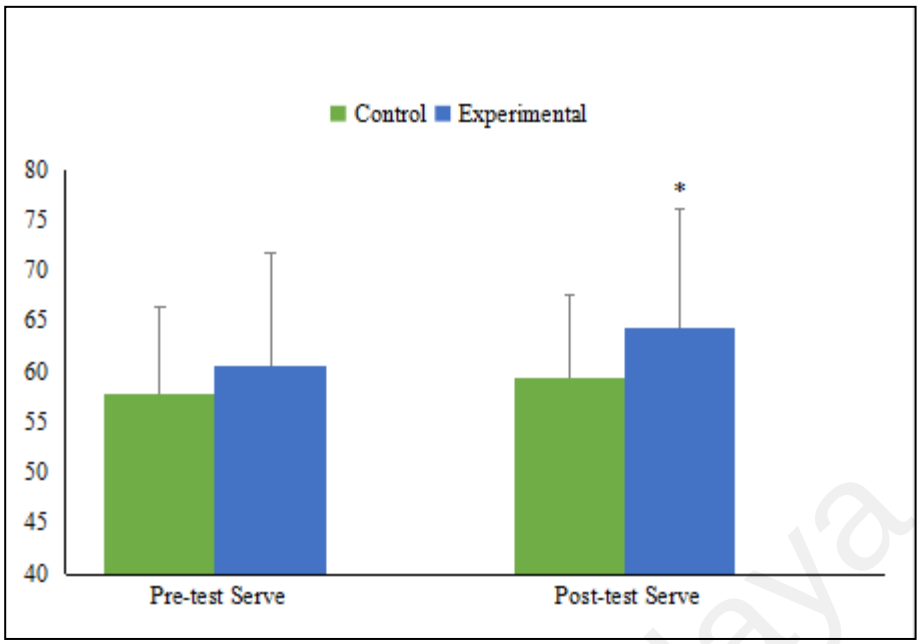

Figure 4.6: Estimated marginal means of pre-test and post-test by groups on Serve

Figure 4.6 shows the estimated marginal means for Serve at Pre-test and Post-test for both control and experimental groups ("*" represents a significant change when compared over time). Experimental group has shown a significant improvement in Serve after the 8 weeks of Easy Five intervention as compared to the control group who went through the tennis match but did not make any significant improvement.

The performance comparison in the Serve performance between Experimental group and Control group was administered and the results indicated that there is a significant difference in the performance of Experimental group but there is no significant difference in the performance of Control group after 8 weeks of treatment.

Results from statistical analysis also indicated that there is no significant difference between Experimental group and Control group after participating in the 8 week training program ($F_{1,28} = 29.55$; $p < 0.05$). There was a significant change in mean scores from Pre-test to Post-test ($F_{1,28} = 9.91$; $p = 0.01$; $\eta^2 = 0.26$) however there was no

interaction between the intervention period and the assigned group ($F_{1,28} = 1.70$; $p = 0.20$; $\eta^2 = 0.05$).

Results from the statistical analysis have shown that there is a significant difference in the performance of Experimental group but Control group indicated no significant difference in the Serve performance after the 8 weeks of Easy Five or the Five Game Situations training program. However, the results indicated that there was no significant difference in the Serve performance between the Experimental group and Control group after 8 weeks of treatment. These results suggested that the Easy Five training program has significantly improved the Serve performance of the junior tennis players while tennis match also has not showed any significant effect on the Serve performance of the tennis players.

4.6.5 Split-Plots Analysis of Variance (SPANOVA) on Agility.

In order to ensure lower Type I error rate, the totals for the two groups are assessed for homogeneity of equal variances using Levene"s Test of Equality of Error Variances.

Table 4.23: Levene's Test of Equality of Error Variances[a] on Agility

	F	df1	df2	Sig.
Pre-test Agility	0.22	1	28	0.64
Post-test Agility	0.50	1	28	0.49

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Table 4.23 above shows the Levene"s Test of Equality of Error Variances for Pre-test and Post-test Agility scores. Both Pre-test and Post-test Agility scores did not violate the assumption of homogeneity of variances ($p > 0.05$).

In order to determine if there was a significant difference between pre-test and post-test scores as a whole and to determine if there was a significant effect on the treatment for both groups, Multivariate Tests using Wilks‟ Lambda was administered and the results are as follows;

Table 4.24: Multivariate Tests[a] using Wilks' Lambda on Agility

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Time	0.32	60.36[b]	1	28	0.00	0.68
Time * Group	0.78	7.98[b]	1	28	0.01	0.22

a. Design: Intercept + Group
Within Subjects Design: Time
b. Exact statistic

Table 4.24 shows the macro-level analysis for Agility scores. There was a significant change in mean scores from pre-test to post-test ($F_{1,28} = 60.36$; $p = 0.00$; $\eta^2 = 0.68$). There was a significant interaction between the intervention period and the assigned group ($F_{1,28} = 7.98$; $p = 0.01$; $\eta^2 = 0.22$).

Table 4.25: Tests of Within-Subjects Effects on Agility

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Time	1.29	1	1.29	60.36	0.001
Time * Group	0.17	1	0.17	7.98	0.01
Error (Time)	0.60	28	0.02		

Table 4.25 shows that there happened to be significant change overtime (pre-test and post-test) in agility scores ($F_{1,28}$ = 60.36; p = 0.001; η^2 = 0.68) and there was an interaction effect suggesting that the changes that occurred overtime happened was due to the type of intervention assigned to the group ($F_{1,28}$ = 7.98; p = 0.01; η^2 = 0.22)

Table 4.26: Tests of Between-Subjects Effects on Agility

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	19317.79	1	19317.79	4713.52	0.001
Group	6.27	1	6.27	1.53	0.23
Error	114.75	28	4.10		

Table 4.26 shows the tests of Between-Subjects Effects. The tests show that there was no significant difference between the group mean scores for agility (F = 1.53; p = 0.23; η^2 = 0.05).

Table 4.27: Pairwise Comparisons Within Groups on Agility

Group	Mean Difference (I-J)	Std. Error	Sig.[b]
Experimental	-0.40*	0.05	0.001
Control	-0.19*	0.05	0.01

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4.27 shows the pairwise comparisons for the means of the Agility scores comparing the group changes overtime. Both control and experimental group showed significant improvements in Agility scores after their 8-week intervention ($p < 0.05$).

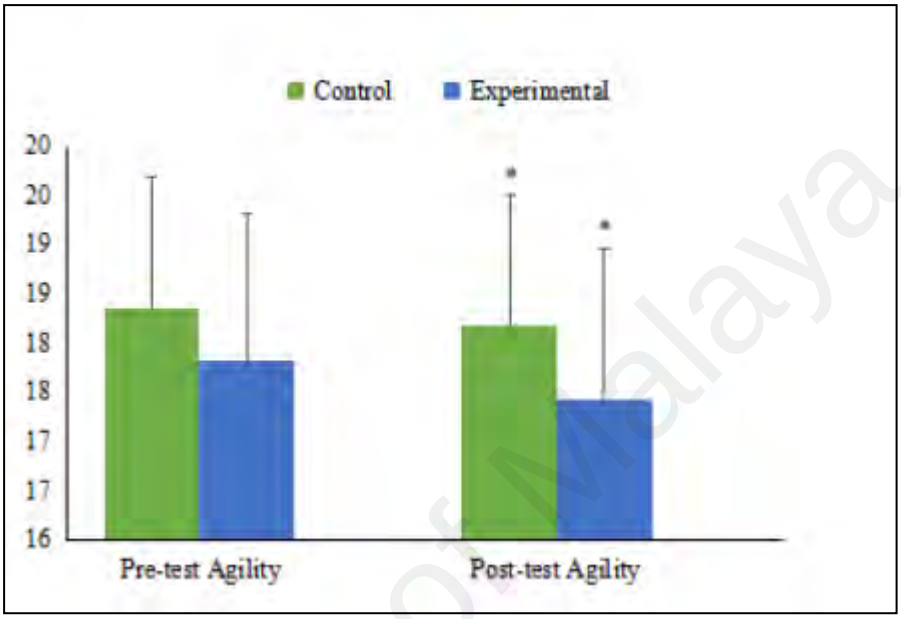

Figure 4.7: Estimated marginal means of pre-test and post-test by groups on Agility

Figure 4.7 shows the estimated marginal means for Agility scores at pre-test and post-test for both control and experimental groups ("*" represents a significant change when compared over time). Experimental group has shown a significant improvement in Agility after the 8 weeks of Easy Five intervention as compared to the control group who went through the tennis match but did not make any significant improvement

The performance comparison in the Agility performance between Experimental group and Control group was administered and the results indicated that there is a significant difference in the performance of Experimental group and Control group after 8 weeks of treatment. There was a significant change in mean scores from pre-test to post-test ($F_{1,28} = 60.36$; $p = 0.001$; $\eta^2 = 0.68$) and there was also a significant interaction

between the intervention period and the assigned group ($F_{1,28}$ = 7.98; p = 0.01; η^2 = 0.22). However, the tests show that there was no significant difference between the group mean scores for agility (F = 1.53; p = 0.23; η^2 = 0.05).

Results from the statistical analysis have shown that there is a significant difference of performance of Experimental group and Control group in the Agility performance after the 8 weeks of Easy Five of the Five Game Situations training program. However, the results indicated that there was no significant different of performance in the Agility performance between the Experimental group and Control group after 8 weeks of treatment. These results suggested that the integrated training programs which include the Easy Five or Five Game Situations training program has significantly improved the Agility performance of the junior tennis players while the same integrated training program that has tennis match also indicated significant effect on the Agility performance of the tennis players.

4.6.6 Split-Plots Analysis of Variance (SPANOVA) For ITN Total Score

In order to ensure lower Type I error rate, the totals for the two groups were assessed for homogeneity of equal variances using Levene"s Test of Equality of Error Variances.

Table 4.28: Levene's Test of Equality of Error Variances[a] on ITN Total Score

	F	df1	df2	Sig.
Pre-test ITN Total Score	2.23	1	28	0.15
Post-test ITN Total Score	3.78	1	28	0.06

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Group
Within Subjects Design: Time

Table 4.28 above shows the Levene"s Test of Equality of Error Variances for Pre-test and Post-test on ITN total scores. Both Pre-test and Post- test ITN total scores did not violate the assumption of homogeneity of variances ($p > 0.05$).

Table 4.29: Multivariate Tests[a] using Wilks' Lambda on ITN Total Score

Effect	Value	F	Hypothesis df	Error df	Sig.
Time	0.31	61.33[b]	1	28	0.001
Time * Group	0.50	27.82[b]	1	28	0.001

a. Design: Intercept + Group
Within Subjects Design: Time
b. Exact statistic

Table 4.29 shows the macro-level analysis for ITN scores. There was a significant change in mean scores from Pre-test to Post-test ($F_{1,28} = 61.33$; $p = 0.001$; $\eta^2 = 0.69$). There was indeed an interaction between the intervention period and the assigned group ($F_{1,28} = 27.82$; $p = 0.001$; $\eta^2 = 0.50$).

Table 4.30: Tests of Within-Subjects Effects on ITN Total Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Time	3153.75	1	3153.75	61.33	0.001
Time * Group	1430.82	1	1430.82	27.82	0.001
Error (Time)	1439.93	28	51.43		

Table 4.30 shows that there was a significant change overtime (pre-test and post-test) in ITN total scores ($F_{1,28}$ = 61.33; p = 0.001; η^2 = 0.69), however, the significant interaction effect shows that the changes occurring overtime are highly dependent on the type of intervention assigned to the group ($F_{1,28}$ = 27.82; p = 0.001; η^2 = 0.50).

Table 4.31: Pairwise Comparisons Within Groups on ITN Total Score

Group	Mean Difference (I-J)	Std. Error	Sig.[b]
Control	-4.73	2.62	0.08
Experimental	-24.27*	2.62	0.001

Based on estimated marginal means

*. The mean difference is significant at 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 4.31 shows the pairwise comparisons for the means of the ITN total scores comparing the group changes over time. The control group showed no significant change in ITN scores at the end of the intervention (p = 0.08) while the experimental group showed significant improvements in ITN scores after their 8-week intervention (p = 0.001).

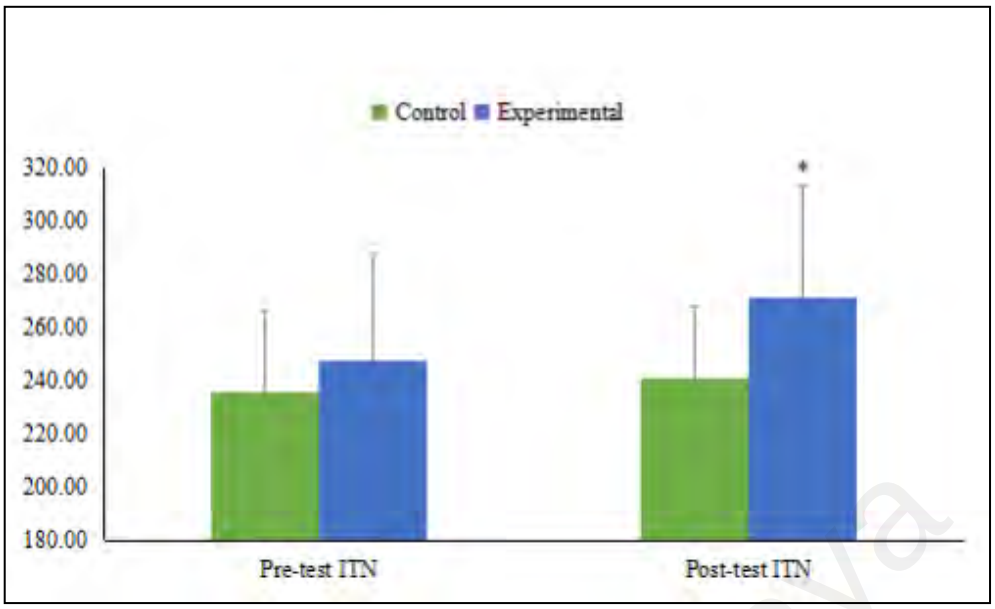

Figure 4.8: Estimated marginal means of pre-test and post-test by groups on ITN Total Score

Figure 4.8 shows the estimated marginal means for ITN score at Pre-test and Post-test for both control and experimental groups. ("*" represents a significant change when compared between groups and over time). Experimental group has shown a significant improvement in the ITN Total Score after the 8 weeks of Easy Five intervention program as compared to the control group.

The performance comparison in the ITN total score between Experimental group and Control group was administered and the results indicated that there is a significant difference in the performance of Experimental group but there is no significant difference in the performance of Control group after 8 weeks of treatment.

Results from statistical analysis also indicated that there is a significant difference between Experimental group and Control group after participating in the 8 week training program ($F_{1,28} = 61.33$; $p = 0.00$; $\eta^2 = 0.69$). Wilks' Lambda indicated that there was a significant change in mean score from pre-test to post-test as a whole ($F_{1,28} = 61.33$; $p = 0.00$; $\eta^2 = 0.69$). There was indeed a significant interaction effect between

the intervention period and the assigned group on ITN total score ($F_{1,28} = 27.82$; $p = 0.00$; $\eta^2 = 0.50$).

Results from the statistical analysis have shown that there is a significant difference of performance of Experimental group in the ITN total score after the 8 weeks of Easy Five or the Five Game Situations training program while the Control group who engaged in the tennis match did not show any significant difference in ITN total score. The result also indicated that there is a significant difference of performance in the ITN total score between the Experimental group and Control group after 8 weeks of treatment. These results suggested that the Easy Five training program has significantly improved the ITN total score of the junior tennis players as compared to the tennis match.

4.7 Summary

Results in the ITN on-court assessment show that the participants‟ ITN total score was 241 which is equivalent to ITN 6. Based on the standard description of ITN, it shows that the participants were at intermediate level and require more efforts to raise the standard of play. Upon completion of the study, the results and findings confirmed that participants from the experimental group have shown statistically significant improvement in their performance based on the results in the International Tennis Number (ITN) On-Court Assessment. It also validates the positive effect of the Easy Five training intervention on Groundstroke Depth, Volley Depth, Groundstroke Accuracy, Serve, Agility and ITN total score. While Control group which was engaged in the tennis match play has shown significant improvement in Agility performance after 8 weeks treatment but has shown no significant differences in Groundstroke

Depth, Volley Depth, Groundstroke Accuracy, Serve and ITN total score. The findings also show that there were significant differences between both groups after the 8-week intervention in Groundstroke Depth, Volley Depth, Groundstroke Accuracy and ITN total score however there was no statistical significant difference in the Serve and Agility performance elicited between the Experimental and Control group.

Therefore, the findings from this study have provided answers for the research questions laid out at the beginning of this study as follows;

1. What is the effect of Easy Five training programme on technical and tactical performance of Malaysian junior tennis players?

   The statistical analysis in this study has demonstrated a significant improvement in all technical and tactical performance components after the 8-week intervention and the results proved that Easy Five training programme is effective on the technical and tactical performance of Malaysian junior tennis players.

2. What is the effect of tennis match play on technical and tactical performance of Malaysian junior tennis players?

   The statistical analysis in this study has demonstrated no significant improvement in all technical and tactical performance components after the 8-week intervention and the results indicated that tennis match is not effective in enhancing the technical and tactical performance of Malaysian junior tennis players.

3. Is there any significant difference between the effectiveness of Easy Five training programme and tennis match play on the technical and tactical performance of Malaysian junior tennis players?

   The statistical analysis in this study has demonstrated a significant difference between the Easy Five training programme and tennis match play in some of technical and tactical performance components namely Groundstroke Depth, Groundstroke Accuracy and Volley Depth after the 8-week intervention but has not demonstrated any significant difference in the Serve performance.

4. What is the effect of Easy Five training programme on agility performance of Malaysian junior tennis players?

   The statistical analysis in this study has demonstrated a significant improvement in the agility performance of Malaysian junior tennis players after the 8-week intervention and the results proved that Easy Five training programme is effective to enhance the general tennis performance of Malaysian junior tennis players.

5. What is the effect of tennis match play on agility performance of Malaysian junior tennis players?

   The statistical analysis in this study has demonstrated a significant improvement in the agility performance of Malaysian junior tennis players after the 8-week intervention and the results proved that tennis match is effective to enhance the general tennis performance of Malaysian junior tennis players.

6. Is there any significant difference between the effectiveness of Easy Five training match play on agility performance of Malaysian junior tennis players?

   The statistical analysis in this study has not demonstrated any significant difference between the Easy Five training programme and tennis match play in agility performance of Malaysian junior tennis players after the 8 week intervention.

7. What is the effect of Easy Five training programme on ITN Total Score of Malaysian junior tennis players?

   The statistical analysis in this study has demonstrated a significant improvement in the ITN Total Score of Malaysian junior tennis players after the 8-week intervention and the results proved that Easy Five training programme is effective to enhance the general tennis performance of Malaysian junior tennis players.

8. What is the effect of tennis match play on ITN Total Score of Malaysian junior tennis players?

   The statistical analysis in this study has not demonstrated any significant improvement in the ITN Total Score of Malaysian junior tennis players after the 8-week intervention and the results proved that tennis match is not effective to enhance the general tennis performance of Malaysian junior tennis players.

9. Is there any significant difference between the effectiveness of Easy Five training programme and tennis match play on ITN Total Score of Malaysian junior tennis players?

   The statistical analysis in this study has demonstrated a significant difference between the Easy Five training programme and tennis match in ITN Total Score of Malaysian junior tennis players after the 8 weeks intervention.

Supervision of structured training programme for competitive junior tennis players is imperative for continued progress and improvement in all performance aspects of the game. Thus, the findings prove that Easy Five training programme is a reliable and effective intervention training programme and is a vital aspect in producing quality high performance tennis players.

CHAPTER 5: DISCUSSION, CONCLUSION & RECOMMENDATION

5.1 Discussion

This chapter presents the discussion of the present study on the experimental research design which involved pre-test and post-test evaluation on the performance of Malaysian elite junior tennis players in the technical and tactical attributes as well as agility performance using the International Tennis Number (ITN) On-Court Assessment. The design of this study focused upon the junior players‟ performances in the pre-test, providing integrated training program which include the Easy Five or Five Game Situations training program and tennis match play to examine if the junior players would improve their performance as the results of the experimental treatment. The junior players were randomly assigned into two groups namely the Experimental group and Control group. The Experimental group was engaged into Easy Five or Five Game Situations training program while the Control group was engaged in the normal training protocols and tennis match for 8 weeks of treatment period.

The process of evaluating the performance in sports is challenging and indefinite. Recognizing an athlete's potential will depends on the coaches‟ ability to identify and understand the full complement of skills demanded in a given sport. Tennis requires a combination of physical, psychological, technical and tactical attributes to perform at the competitive level. As such, this final chapter explains in several parts that include the discussion of performance attributes based on the final results of the research leading to general conclusions to be derived from the thesis. This involves a discussion of the theoretical issues raised especially on the success of the research method using the Easy Five training program and its relation with previous research and then followed by issues that indicate certain crucial characteristics that should be examined for future

research as well as recommendation for the benefits of the sports associations and coaches.

The aim of this study was to compare the effects of Easy Five or Five Game Situation training and tennis match play on the technical and tactical performance of 12 to 16 years old Malaysian junior tennis players using the International Tennis Number (ITN) On-Court Assessment. The beginning of the intervention period and the end of an 8 weeks period were determined to be the measurement dates of pre-tests and post-tests. The performances of all participants were assessed prior to the intervention in order to have a general idea of the existing performance of all the participants.

5.1.1. Performance Analysis

The results from this study indicate that mean total score of ITN = 241 and is equivalent to ITN 6 as referred to the Description of Standard (International Tennis Federation, 2003) in Appendix C. The ITN On-Court Assessment was developed by International Tennis Federation (ITF) in 2003 in order to provide a standard method of classifying skill level of tennis players, globally (Crespo, Reid & Miley, 2003). The ITN On-Court Assessment consists of five different sections which are Groundstroke Depth, Volley Depth, Groundstroke Accuracy, Serve and Agility. In order to facilitate the rating players, the ITF has developed a description of standards and an objective "On-Court Assessment" both of which can be used to rate players in the absence of competition results (International Tennis Federation, 2003). The ITN 6 as being observed in the pre-test of the Malaysian junior tennis players indicates that the player exhibits more aggressive net play, has improved court coverage, improved shot control and is developing teamwork in doubles.

The findings from this study revealed that the participants in Experimental group who engaged in Easy Five or Five Game Situations training program for 8 weeks has shown improvement in all performance attributes namely Groundstroke Depth, Groundstroke Accuracy, Volley Depth, Serve, Agility and ITN total score. In the pairwise comparisons within groups test to analyze the difference between pre-test and post-test, the Experimental group showed significant improvement in Groundstroke Depth ($p = 0.001$), Groundstroke Accuracy ($p = 0.001$), Volley Depth ($p = 0.001$), Serve ($p = 0.01$), Agility ($p = 0.01$) and ITN total score ($p = 0.001$). Control group only showed significant difference in Agility ($p = 0.001$) but did not show any significant difference in Groundstroke Depth ($p = 0.91$), Groundstroke Accuracy ($p = 0.31$), Volley Depth ($p = 0.25$), Serve ($p = 0.20$) and ITN total score ($p = 0.08$).

In the pairwise comparisons between groups test to analyze the difference between Experimental group and Control group after 8 weeks treatment, no significant difference was found between both groups in Serve ($p = 0.19$) and Agility ($p = 0.17$). Even though Experimental group showed an improvement in Serve and Control group did not show any significant difference in Serve but statistical analysis indicated that both groups did not show any significant difference in the post-test. Nevertheless, the statistical analysis showed a significant difference between Experimental group and Control group after the 8 week treatment in the Groundstroke Depth ($p = 0.01$), Groundstroke Accuracy ($p = 0.01$), Volley Depth ($p = 0.01$) and ITN total score ($p = 0.02$). Experimental group indicated an improvement of 3.87 points in the post-test of Serve and showed a significant difference after the treatment however Control group also indicated a very small margin increase in Serve with 1.6 points in the post-test but statistical analysis did not show any significant difference in the Control groups after

the 8 weeks treatment. Therefore, there is no significant difference was observed between Experimental group and Control group in Serve.

Tennis is a complex sport and it has many open skills but serve is the only closed motor skill in tennis which implies that the player initiates the action and can therefore control the entire movement (Coelho et al., 2007) Since tennis serve is a self-paced, player can initiate own skill, imagery training can be beneficial to improving serve performance through increased accuracy and consistency (Lauer, 2014). This is supported by Coelho et al. (2007) who suggested that closed skills should be more affected by imagery and athlete can use imagery to visualize the skill precisely. There is possibility that the serve can be improved through consistent training and repetitive practices. Therefore it can be suggested that players who involved in tennis match can also improve their serve based on constant practice or other factors. Players involved in the combined strength training program can also improve their serve performance through an improvement in the kinetic chain (Kovacs & Ellenbecker, 2011). These are the possibilities that in this study no significant difference on Serve could be observed between Experimental group which engaged in the Easy Five and Control group which employed tennis match in the 8 week treatment.

The Spider Run Test which takes part in ITN was administered to measure the agility performance of the participants. Agility is the only fitness component included in the ITN On-Court Assessment as it is the physical ability that most influenced the competitive level of young tennis players (Kovacs, 2006). This is also supported by Sánchez, López and Pagán (2016) in their research when their findings revealed that advance tennis players demonstrated higher scores in agility and better level players achieved better agility scores in each of the test conducted.

Crespo and Miley (1998) defined agility as an ability while moving to start, to stop and to change direction quickly and effectively. Results from this study indicated that the mean agility score of each group progressed significantly from pre-test to post-test. Nevertheless, no significant difference was found in the mean difference of pre-test and post-test of the two groups. Both groups had gone through the same integrated training program for 8 weeks which includes the fitness training beside the treatments. This could determine the significant improvement in agility in both groups. However, the Easy Five or five game situations training and tennis match play may have a significant effect on the agility performance. According to Leone et al. (2006), tennis is an intermittent sport and can be characterized by repeated high-intensity short bursts of running and multiple explosive changes of direction. Hence, improvement of agility performance can be related to activities in a regular tennis training program.

The duration of a tennis match is often more than one hour even though rallies typically only last around five to seven seconds, and within this time frame a tennis player would on average run three meters per shot and a total of eight to twelve meters per point (McKinley & Sato, 2014). Along with this intense aerobic activity players will often complete three hundred to five hundred high intensity efforts during a best of three sets match (Fernandez, Mendez-Villanueva & Pluim (2006). During a match there is a combination of periods of maximal work and longer periods of moderate and low intensity activity. A collection of descriptive research outlines tennis match play to require players to cover 3 meters per shot for a total of 8 to 12 meters per game point over 6 to 8 seconds duration (Fernandez-Fernandez et al., 2009: Ferrauti et al., 2001) resulting in 600 to 800 meter per set. The work of Ferrauti et al. (2003) further scrutinized these gross movement demands, classifying approximately 80% of all

strokes to be played within 2.5 meters of the player's ready position and approximately 10% of strokes requiring players to traverse 2.5 to 4.5 meters.

During an average tennis match a tennis player will complete around four directional changes per point (Fernandez et al., 2006). These directional changes can be further broken down into three categories as tennis players move 1) forward forty-seven percent of the time, 2) sideways forty-eight percent of the time, and 3) backwards five percent of the time (Parson & Jones, 1998). Within a regular match of two sets there is generally forty-eight points scored. This results in approximately one hundred and ninety-two directional changes in a regular match. Therefore the activities in regular tennis matches can also contribute to the improvement in Agility performance. The findings from these previous studies could explain the reason why both groups showed significant improvement in Agility after the 8 weeks treatment.

The results from statistical analysis revealed that the mean of Groundstroke Depth, Volley Depth, Groundstroke Accuracy, Serve, Agility and ITN total scores of Experimental group increased significantly after the intervention training program while the Control group did not show any significant difference in any of dependent variables except for Agility. The improvement of all these technical and tactical performance demonstrates the effectiveness of Easy Five or Five Game Situations in the performance of the junior tennis players. The findings also indicated that tennis matches did not affect the technical and tactical performance significantly. Participation in the Easy Five or Five Game Situations training enhanced the tennis playing level of all participants as compared to the participation in tennis match play. This is supported by previous research conducted by McPherson (1991), McPherson & French (1991) and Turner (2003) which confirmed that because of the game based approach training method,

tennis players demonstrate better game performance such as shot precision and have higher level of specific knowledge than players coached according to traditional approach.

Even though there are not many research conducted previously on Easy Five or Five Game Situations but the findings from this study was supported by research conducted by Suna (2013), which was aiming to determine the effect of aerobic, anaerobic, technical and combined trainings on the performance of tennis players using International Tennis Number (ITN) on-court assessment. The average ITN pretest score was found as 124.30 points; and the average post-test score was found as 193.50 points. Results of the study showed a significant difference on the statistical comparisons applied on the study. Suna (2013) stated the results of performance increment that uniting the combine training which develop the motoric skills with technical trainings.

In another research conducted by Suna, Alp and Çetinkaya (2016), which was conducted to determine the effect of technical training on stroke performances of 10 to 12 years old male tennis players, observed a significant improvement in the skills of the participants. In the study, technical training for 3 days and fitness training for 1 day were applied to the athletes. The result of 12-week training showed the average ITN pre-test scores of the participants was 147.21 points, whereas their post-test scores was found to be 160.51 points.

In the study of Özcan (2011), which was aiming to determine the effect of two different training methods on biomotoric and physiological characteristics in basic tennis technical education, the athletes were divided into two groups and tennis training was applied on one of the groups with inductive method and deductive method was

applied on the other group. In the study, ITN test was used to determine improvements of tennis players. As a result of the study, significant difference was found between ITN pre-test and post-test scores of tennis players received tennis training in both groups. Another study by Söyleyici (2011), which was aiming to determine the intensive 8-week strength and technical training on biomotoric and technical development of tennis players in the technical tennis training, the average ITN pre-test scores of players was found as 75±0,0 points and their average post-test scores was found as 148,9±18,2 points. At the end of the study, the increase in ITN scores of the athletes was found to be statistically significant.

These previous results are consistent with these research findings even though different methods of intervention were applied. In addition, result on the study the Çalışkan (2014) aimed to determine the effects of strength and technical trainings applied to children on tennis skill development and some motoric features. As a result of ITN On-Court Assessment test values, he found that there was a significant difference. He stated in the study as the same as Suna (2013) that applying motoric and technical training contemporaneously will affect the tennis skills positively. His findings support the results obtained from this present study that planned and systematic training program will provide significant improvement on the tennis performance.

5.1.2 Technical Performance of Junior Tennis Player

There are three main types of tennis strokes which are the serve, the groundstroke and the volley. According to Bahamonde (2000), tennis serve is considered the most important and critical stroke in tennis. It is well known that fast serves can dominate the game at elite levels (Bahamonde, 2000). In addition, it was also suggested that skills related to tennis strokes can be used to predict competitive success at the age of 8 to 12

years (Roetert et al. 1992). The importance of groundstroke in tennis was pointed out by Crespo and Higueras (2001) that the ability to control forehand ground strokes as to hit the ball with immense power is a distinguishing feature of the modern game. Younger players still need to develop this ability, which among other skills it might separate the elite from the high performance athletes. Although the forehand groundstroke is the second most frequent stroke in service games on a professional level (Johnson, McHugh, Wood & Kibler, 2006), it has to be taken into serious consideration by most of the coaches in any intervention approach.

Volley is an offensive technique often used by tennis players which plays a key role in competitive tennis competitions and this is supported by Tiley (2002) who mentioned that one of the winning game plan is by attacking on a short ball by the opponents and taking steps into a good volleying position. Since volley is typically played at or near the net, less time is available to prepare for the shots therefore proper preparation is crucial for the volley (Roetert & Groppel, 2001). It shows that volley is one of the key performances in tennis technical skills.

In tennis serve performance, the relation between speed and accuracy is critical (Brody, 2003). Normally, first serves have greater velocity, players being successful in hitting the ball in the proper serve area about 40% to 70% of the time (Davids et al., 2006). In contrast, second serves have a slower velocity ball and a much higher probability of landing in the proper court (near 90%). Hence, players adjust the speed of the serve and these two factors must be considered to evaluate serve performance (Davids et al., 2006). In addition, regularity of the performance such as low performance variability, as well as percentage of successful serves and percentage of

points won after first serve during tennis matches, are three complementary relevant indicators of serve performance (Brody, 2003).

A tennis player must have the ability to serve with power, speed and accuracy in order to be competitive at high performance level (Zingaro, 2008). The game of tennis demands many factors such as movement on the court and mastery of a variety of strokes in order to have a great performance. Serve is one of the important factors for good performance and it can be improved in many ways, including the selection of rackets, musculature core strength and good internal focus as important component of power serve.

Schönborn (2002) recommended that modern technical training should concentrate on two main aims:

1. Create new, direct relationships between conditioning and technical elements using real game situations.
2. Establish training forms which resemble match situations, but which can be successfully solved during training. In other words, train all rally variations that are more often than not, unsuccessfully resolved during matches.

The present study which demonstrated the effectiveness of Easy Five or the Five Game Situations supported the recommendation by Schönborn (2002). The findings from performance analysis proved that by using the real game situations in the training program and establishing training forms that resemble match situations significantly enhanced the performance of junior tennis players.

5.1.3 Tactical Performance of Junior Tennis Player

The tactical component takes into account all of the variables a player implements during a tennis match. Tactical skills are defined as "the decisions and actions of players in the contest to gain an advantage over the opposing team or players" (Martens, 2004). How a player performs during a match competition involves certain tactics. Consistency, placement, patterns, spins, power, shot selection and competitive situations are the seven tactical sub-components (Parker, 2008). Parker (2008) defines each of the sub-components as follow;

1. **Consistency** is a player"s ability to get the ball back more times than the opponent using optimum pace and control, while hitting shots to a specific target or area without error.
2. **Placement** represents the ability to hit the ball to the selected target. It allows a player to run the opponent, pick on his weaker side, wrong-foot him or hit into the open court.
3. **Patterns** are combinations of shots and shot sequences utilized during a point that emphasize a player"s strengths and exploit the opponent"s weaknesses.
4. **Spin** is simply the direction the ball is rotating when it comes off the racquet. Spin can be manipulated by the path and angle of the racquet face at contact, and it allows a player to control the speed and trajectory of his shot, making it more accurate.
5. **Power** is the amount of speed put on a shot and the ability to develop pace on a ball. It is generated through the combination of a player"s strength and the kinetic chain. It is imparted on shots for both offensive and defensive purposes.
6. **Shot selection** is a player"s ability to recognize what is going on in the point, understand the shot options available to him and choose the best possible shot

based on all the information he has gathered. It requires fast thinking and split-second decision making.

7. **Competitive situation** in a match, it is essential for a player to know how to best select his tactics and shots to play and win the next point or game. Mental focus and toughness play a significant role into choosing the right shot, going with the proper patterns, and using optimum placement and consistency.

Study by Scully and O"Donoghue (1999) demonstrated the interaction between knowledge and decision making. In their study they analyzed matches based on a change in tactics that the eventual winner of the match adopted based on the score. The results showed that the winners of the matches made similar changes in their tactics based on whether they were leading, even or behind in the match. This demonstrates that elite tennis players are able to combine their knowledge of the game and situations that arise during competition to make decision on how to play the match from these situations.

In another study, McPherson and Kernodle (2007) looked at the differences between adult beginner and entry-level professional tennis players. Using the coding method originally designed by McPherson (1991), the authors investigated the structure of problem representations and concept content that was verbalized by players during immediate recall and planning interviews. The results of their research showed that high skill levels were accompanied by an increase in the tactical problem representations. The varsity players and the professionals showed more action plans and current event profiles in response to situations that occurred on the court compared to the beginners and advanced beginners. In differentiating between the tactical prowess of varsity

players and professionals, it was found that varsity players planned specific shots and techniques while professionals planned shot types, predicted their opponent"s responses and had more specific goals. This demonstrated that the elite players use their knowledge built up over years of competition to make tactical adjustments in their play in order to take advantage of opponents" tendencies in previous game situations.

Based on the findings in this study, it clearly shows that coaches must emphasize adequate tactical training as knowing what to do and being able to perform in controlled contexts which is related to being able to select an appropriate response and execute that response in game context (Rink, French & Tjeerdsma, 1996). Mastery of the technical skills of tennis is important however tennis players must also be able to enhance the tactical skills of the game. Some tennis coaches overlook the tactical aspects of the game and even omit tactical aspects from training because they are so engrossed on coaching technical skills. Martens (2004) suggested coaching approach of tactical skills is by focusing on three critical aspects known as the "tactical triangle":

- Reading the play or situation
- Acquiring the knowledge needed to make an appropriate tactical decision
- Applying decision-making skills to the problem

Transferring tennis skills from training to the match competition can be difficult however mistakes or errors can be reduced by placing the tennis players in game situations during training to work on tactical skill decisions. Majority of the coaches in the study by Thomas (2011) cited "learned by myself" as the most frequent method by which they learned about tactics in tennis. Irwin, Hanton and Kerwin (2004) found that trial and error was the second most cited method by which gymnastics coaches gained knowledge, but the use of mentor coaches was deemed the most important source. Therefore, it is important

that the coach be correctly educated about tactics in tennis. The coach must possess the correct tactical knowledge for all situations and the coach must know how to deliver this knowledge to the player.

The main measurement in the ITN On-Court Assessment is the effectiveness and function of the tennis stroke which include the stroke‟s placement or depth, power and accuracy rather than the standard form of stroke technique. This is very much correlated to the Game Based Approach in training or the game situations. The ITN On-Court Assessment evaluates the combination of technical and tactical performance of tennis player based on these attributes. With the results obtained from the testing protocols and descriptive values, coaches can design individual performance profiles of the players with their respective strengths and weaknesses. This would lead to a more efficient design of training programs and saving time for tennis-specific training (Ulbricht et al., 2013).

5.1.4 Agility Performance of Junior Tennis Player

The descriptive parameters of physical fitness abilities indicate that the Malaysian elite junior tennis players showed an average performance in agility with mean = 18.09 while in the Experimental group, the agility performance was mean = 17.82 and agility performance for Control group was mean = 18.36. Based on the norms of Spider Run test for agility (USTA, 2008), the agility performance for Experimental group is average but the Control group as well as the overall performance of junior players requires an improvement.

A study by Dobos and Nagykáldi (2016) on 14 years old and under boys elite tennis players in Hungary (N = 20) who were ranked among the top 40 in their age group and

who had three to five years of tennis competition experience in international and national tennis tournaments showed that their average performance in agility was 20.65. A study on 40 young tennis players age = 15.1 ±0.4 years old in Israel with six to eight years of playing experience showed an agility performance of mean = 16.3 (Meckel et al., 2015). A study also was conducted among Dutch junior players aged between 13 to 16 years old and were ranked in the Dutch national ranking where their average agility performance was 17.40 (Kramer et al., 2017). These descriptive statistics indicate that the Malaysian junior tennis players need to improve their agility performance based on the norms as per Appendix E (Kovacs et al., 2007).

This study was focusing on agility among all the fitness attributes required for tennis performance since agility has been identified as the most important fitness component in tennis performance. A previous study by Kovacs (2006) demonstrated that agility was the physical ability that most influenced the competitive level of young tennis players. A study by Kuroda et al. (2015) found that, among the junior players, agility performance was significantly higher in the superior group than in the average group. This indicates that agility contributes significantly to the performance of junior tennis players. Tennis players are required to possess superior agility and an explosive "first step" speed to address the ball after it has been hit by their opponent (Groppel, 1986). Furthermore, according to the International Tennis Federation (ITF), senior men can cover a tennis court in 3.5 steps, whereas it takes junior players 4.7 steps to do the same. In addition, junior tennis players‟ bodies are still developing, and therefore, they are not able to cover a full-sized tennis court in the same way as senior players. This is the possibility that good junior tennis players demonstrated greater agility as compared to the average players.

Competitive tennis requires players to continuously generate powerful strokes and rapid on-court movements over an extended period of time during tennis matches. In the recent years, the speed of tennis strokes has increased and players have to move quickly in different directions to be able to reach the ball and to hit it in the best possible conditions (Domínguez, 2011; Sánchez-Alcaraz, 2013). Thus, agility is a very important component in those sports that demand a direction change (Jones, Bampouras & Marrín, 2009), defined as "a rapid movement of the whole body changing direction as a response to a stimulus" (Sheppard, & Young, 2006). Different findings from different research show that 60% to 80% of the motion or movement during a tennis match is lateral, between 10- 30% is linear and forward, and between 8% to 10% is linear and backwards (Pieper, Exler & Weber, 2007). Besides, tennis players change direction an average of 4 times per point (Roetert, Ellenbecker & Chu, 2003), but it is possible to change from just one movement to more than 15 changes of direction during a point (Kovacs, 2009). Thus, initial acceleration and deceleration or stopping phase, and the capacity to make multi-directional explosive movements will be vital components for tennis players, and will determine their performance (Kovacs, 2007; Sánchez-Alcaraz, 2015).

A tennis player requires quick movement on the court during matches. The time required on how fast a tennis player can get to the ball could be the difference between success and failure. Tennis requires the athletes to be fast over short distances, in multiple directions and have the ability to develop explosive starts from various positions (Hornery, 2007). The importance of the agility skill is proven in investigating relationships among an array of performance and clinical variables which indicated that agility was the only physical performance variable used to predict competitive rankings in 83 prepubescent tennis players (Birrer et al., 1986). Birrer et al. (1986) found in a 5-

year study of over 500 pre-adolescent athletes, that athletic ability performance parameters were poor predictors of rankings. Roetert et al. (1992) concurred with the findings of Birrer et al. (1986). They indicated that agility was the only physical performance variable used to predict competitive rankings in 83 prepubescent tennis players. A study by Maman et al. (2011) showed a positive relationship between agility training and tennis performance. These findings proved the correlation of agility in the tennis performance and supported the inclusion of agility test in ITN On-Court Assessment for the performance profiling of technical and tactical skills in the present study.

It can be reiterated from the previous research as discussed in this chapter that agility is very significant for success in tennis performance. As such, in any training program, coaches should take the time and efforts to address this critical component of fitness in bringing out the best potential of their players as to be competent enough in the high level competitions. It is a fact that regular performance assessment is an important part of optimizing performance and can certainly enhance tennis playing efforts and outcomes.

5.1.5 The Vital Performance Attributes of Tennis Player

Throughout the above in-depth discussion of the research findings, the researcher has wind up certain important elements as well as attributes of a tennis player which should be adopted in tennis training intervention programs as a benchmark of many previous studies. Player profiles show the typical values for performance indicators as well as an indication of variability in these values between performances (James, Mellalieu & Jones, 2005). O'Donoghue (2005) mapped performance indicator values onto percentile norms to help interpret the typical value for a player as well as the spread performances

about the typical performance. This will help coaches to understand their player"s performance when playing against different types of opponents.

Nevertheless, few studies have addressed the performance needs of competitive teenage (12 to 16 years old) tennis players (Roetert et al., 1996). Dramatic changes in physical attributes typically occur at the age of about 12 to 15 years, but there is a large inter-subject variability in the timing of maturation. For example, the age of peak height velocity is known to influence to a great extent of the physical factors. However, according to Malina et al. (2005), it is still unclear on how the stage of maturation influences the acquisition of the specific technical skills. Therefore, the influence of physical abilities on tennis play may be more apparent during this time of development due to dramatic increase in strength, size, and endurance (Pratt, 1989). Knowledge of the relationship between various physical attributes and the ranking of junior tennis players could assist in determining the relative importance of such measurements and providing optimal training programs.

The technical attributes are also one of the vital characteristics that influence the development of any successful tennis player. These findings supported similar studies whereby technical proficiency of players can also be evaluated using notational analysis, although there have been fewer studies of this area of application. Taylor and Hughes (1998) had compared the patterns of play of elite junior squash players from Britain, Europe and North America. They were able to establish that, British players had technical deficiencies on their backhand when playing ground strokes. They were better than the Europeans when volleying but less skilled than the Americans, who had better all-round technical abilities and were able to adapt easily to different surfaces and different tactics. There would seem to be a scope for more application in this area.

Several interesting items of research have been carried out in tennis concerning the field of time and game characteristics however, they covered only a small number of tennis matches played by players of various ages and quality categories. A group of German experts, Lames, Perl, Schroder and Uthmann (1990) presented the project of establishing the expert tennis system, called TESSY or Tennis Simulation System. The TESSY system functions within the scope of three major phases, namely: description and observation of the game and tactics, processing and interpretation of results and the transposition of obtained results into practice. These researchers processed the final match of the 1989 Wimbledon tournament, played by world no. 1 and no. 2 then, Boris Becker and Stefan Edberg. The serve analysis showed that Becker was successful in long serves directed into both corners of the service court. On the backhand side of the court mostly all serves were straight. Contrary to Becker, Edberg had difficulties with the length and direction or accuracy of the serve. Most often, he used the body serve which is right: 17.8% and left: 12.7% as well as the spin serve. The analysis confirmed the finding about the great importance of tactical attributes of return in matches played on fast courts. The importance of faults in defense and offense is clearly distinguished depending on which player has the serve. Baseline game is of no particular significance on such fast court. The final conclusion of the researchers was that the system provides the opportunity for presenting expert knowledge in a certain sports field, that such procedure can be included in the interpretation of a complex sports achievement and that the existing intuitive rules are checked by means of the system as well as new ones formulated.

It is recommended that tennis players train in a specific manner to improve tennis specific performance and to reduce injury. Most training drills should simulate the time requirements experienced during match play which is between 5 to 20 seconds with

appropriate work to rest ratios (1:3 to 1:5). As speed, agility, and maximum velocity movements respond to specific and individualized training, it is important that tennis players focus on training distances seen during match play (<20 meters), with drills combining linear, lateral, and multidirectional movements (Kovacs, 2006). Since the sport of tennis has evolved dramatically in the last few years, more research is needed into all aspects of training. Some quality research was conducted in the 1980s and 1990s, but as the speed of the game, the types of athlete as well as the strategy of game have developed, tennis research must also put an emphasis on these areas. More information needed to be obtained during tournament play and its effects on the performance. There are also quests over methods of training that are most beneficial and efficient both from a performance enhancement aspect.

5.1.6 The Practical Characteristics of Tennis Coaching

A major transformation in coaching methodology has been the catalyst of structuring the teaching and coaching process with the idea of adapting it to the match situation or game based and thus emphasizing the tactical approach to coaching (Unierzyski & Crespo, 2007). While the ability to perform a technical skill effectively is vital to performance, suitable judgments concerning what to do in the game situation are also paramount. Therefore the aim of the tactical approach to coaching tennis is to improve the overall game performance of the player combining tactical awareness and skill execution (Crespo & Cooke, 1999). Research by McPherson (1991), McPherson and French (1991) and Turner (2003) confirmed that because of game based approach tennis players demonstrate better game performance and have higher level of specific knowledge than players coached according to conventional approach.

As discussed earlier, the game of tennis is based on assumption that at any given moment the players must be in one of five game situations (serving, receiving, playing at the back of their own court with the opponent at the back of their court, approaching or at the net, playing at the back of the court with the opponent approaching or at the net) (Tennant, 2004). In each of these situations, tennis players will have to execute some specific tactics. Therefore, the goal of training programs must be focused on how the players will be able to handle and react to these different game situations. Hence, the training programs should emphasize on the ability of the players to take effective tactical decisions. The technical based approach is also a necessary form of coaching but it has to be integrated with the tactical approach as well to promote the effective training of tennis since the tactical ability will assist the players to solve problems encountered during the match. This can only be achieved by practicing in the game situations. Therefore the goal of coaching process in all modern methods around the world is to teach how to deal in these five game tennis situations (Unierzyski & Crespo, 2007).

Improving tennis performance is the goal of every tennis coach and player. The practicality of this information should be employed when designing training programs for high performance tennis players. Age, sex, style of play, physical components, technical components, tactical components, and psychological components will all determine the success of the tennis athlete (Kovacs, 2006). Effective planning of training program will help in designing a successful program to help optimize performance of athletes. Coaches are responsible to explain and to train their athletes systematically on the basic technical skills and shot patterns that make up the game. These technical skills are the fundamental that provide tennis players with the tools to execute the physical requirements of the game (Anderson, 2009). During practice,

coaches must be creative to create scenarios on the tennis court in which players have to use their technical skills in competitions or matches like situations, forcing them to make decisions that simulate the choices they will have to make in a match. These tactical skills are the link between practice performance and match performance. Although the proper execution of technical skills is necessary for success, the tactical skills such as the ability to make the appropriate decisions are the key to have the peak performance when it counts during competition (Anderson, 2009).

Obviously, other types of skills such as pure physical capacity, mental skills, communication ability, and character traits all contribute to athletic performance (Martens, 2004). Although all these skills are important, effective teaching of the technical and tactical skills provides the foundation for successful tennis coaching. Consequently, to be successful in tennis or any other sport requires very special qualities. These performance qualities or attributes can be divided into four categories as discussed earlier which are the physical, psychological, technical and tactical abilities. Without questions, these attributes can be developed to their fullest potential with hard work and effective training methods. Nevertheless, most people are excluded from becoming the best tennis player in the world, no matter how much effort they put, how much time they spend and how hard they work attempting to reach their optimum potential.

Prior to those technical skills are the specific procedures to move one‟s body to perform the task that needs to be accomplished (Martens, 2004). The proper execution of the technical skills of tennis is obviously crucial to successful performance. Most coaches, even those with little experience know what the basic technical skills of tennis are; serves, return of serves, groundstrokes, volleys, approach shots, lobs, and

overheads. But the ability to identify the most practical and feasible ways in coaching athletes on how to perform those skills usually develops only over a long period with an accurate intervention training programs as effective coaches have the capacity to transfer their knowledge and understanding of skills into improved performance of those skills by their athletes (Anderson, 2009). In an excerpt taken from a book title of "Coaching Tennis Technical & Tactical Skills*"* written by Anderson (2009), it is clearly stated that a viable coaching program should imply certain technical elements towards any tennis intervention program such as:

- Clearly communicate the basic elements of each technical and tactical skill with the athletes.
- Construct drills and teaching scenarios to rehearse those technical and tactical skills.
- Detect and correct errors in the athletes‟ performance of technical and tactical skills.
- Help athletes to transfer knowledge and ability from practice to matches.

Mastery of both technical skills and tactical skills of tennis is paramount. A good technical and tactical training prepares tennis players for match situations. By incorporating game situations into training program, it will improve the ability of tennis players to transfer their skills from practices to matches or competitions. The game based approach emphasizes the use of games to provide tennis players with situations that are as close as possible to a real match (Launder, 2001). This training approach or the game situations training provides players with a competitive situation governed by clear objectives and focused on specific individuals and concepts (Anderson, 2009). The game situations training approach also allows tennis players to experience a

productive and meaningful training environment where players are motivated by the structure of the training programs and the improvements they gain.

The principle of specificity states that training is of the greatest benefit when it reflects the requirements of the actual performance (Morante, 2006). Consequently, optimal competitive tennis performance would be achieved through a practical and feasible training program that is similar to the characteristics and demands of performance in competitions. In order to ensure maximum specificity and benefits from training, the demands of tennis should be determined with the subsequent training program being designed around the activity profile of the sport.

5.2 Conclusion

This experimental study focused on the importance of Easy Five or the Five Game Situations training. Effect of the Easy Five and tennis match play on the tennis players‟ performance was investigated. Based on the findings, it can be concluded that the Easy Five or the Five Game Situations training is more effective and viable method in order to enhance these parameters of performance than the tennis match play. The study has indicated that the five game situations training was statistically significant to the performance level of players identified through the ITN levels. However, tennis match play also has shown a significant difference in agility. In the effort to determine the contribution of five game situations training and tennis match play to predict the performance level of tennis players, the possibility of testing the relationship between these measures and performance levels during competitions or strokes production may justify further study. More investigation on the relationship of ITN levels with other performance attributes will allow more information and develop specific training program to improve the performance of the players.

The coaching process is about enhancing performance by providing feedback about the performance to the player. Researchers have shown that human observation and memory are not reliable enough to provide accurate and objective information on complex sports (Franks & Miller, 1986). Therefore, performance assessment provides an insight into the players‟ current performance in the sport. By breaking down their game in the process, players gain a clearer picture of their abilities and how to work towards improving them. Adoption of a multifaceted approach to performance assessment was an exclusive contribution to the study. In particular, the performance analysis demonstrated the extensive nature of the thesis. As mentioned earlier, a tennis intervention training program is a method of honing, developing and transferring skills from practice to matches which can be a difficult task. A sound background of physical, psychological, technical and tactical training program should prepare athletes for competitions. Incorporating match like situations into routine training however increases the probability that players will transfer skills from practices to matches effectively. Based on the findings, it can be concluded that Malaysian junior tennis players have the potential to adopt an effective training programs in order to enhance their performance and raise their standard to the next level. This thesis revealed that training intervention programs play a significant role in enhancing the optimum capabilities of selected junior players and performance analysis process will assist coaches to understand their players better. Although there are many resources of tennis training instructions and training programs exist from books, video tapes and online resources, it is difficult to find a structured and specific training protocol which provides an integrated performance progression and is based on proven program to improve performance. As such, the Easy Five training approach that was used in the intervention program is a viable method in formulating training programs and enhancing the performance of a tennis player in future.

In conclusion, the practicality of information gathered from this study can be applied when designing effective training programs for elite tennis players. Coaches will be able to analyze the results and be able to enhance future performances. Hughes & Franks (2004) explained that feedback was crucial for the improvement in performance of athletes. There are many factors which include the physical, psychological, technical, tactical aspects that will determine the success of the tennis athletes. Effective and quality training programs will definitely help in developing a productive and reliable program to optimize the performance of tennis players. The assessment process can be done every 3 months or 6 months to update the progress of players‟ performance and to ensure that it is up-to-date with the players training needs or requirements. It is recommended that coaches assess their players‟ performance on a regular basis in order to ensure better compliance with the training program. The aim of formulating an effective training program such as the Easy Five is to optimize the option and the potential of junior tennis players in engaging better prospect of enhancing their performance as well as a guideline for tennis coaches at various levels in preparing and designing quality and effective training programs.

5.3 Recommendation

Tennis performance skills which include technical, tactical and agility profile attributes that have been discussed earlier in this thesis are very essential in enhancing the performance of tennis players. However, these findings also suggest that further research in this area is likely to assist sport scientists and coaches in developing a more thorough understanding of the importance and the effectiveness of tennis performance. Therefore, this study should be conducted in large population scales and expanded to the athletes from other sports as well. Probably this study can also be extended to not

only for the performance enhancement in tennis but also focusing on other racket sports in Malaysia, such as squash, badminton and table tennis.

Most of the training and testing procedures in this study were performed on the tennis court and it can be recommended that this study can be conducted during a non-season period in which the players are not busy preparing for important tournaments or school competitions. Further research is required to determine if this training program can reduce the incidence of injuries in tennis players as well as to determine the demand of performance profile of tennis in different group of players. Further study on higher-level competition players will be able to provide more precise information on the possible relationship or significance of training programs on ITN level of players‟ performance.

Upon observing the process of training and performance development of junior tennis players for the completion of this thesis, the researcher has formulated RAHIM Training Principle which can be used as guidelines for future training program or research. Bench marking from many previous studies of tennis intervention programs, the researcher has indicated five important combinations of the training characteristics in the acronym of R.A.H.I.M to enhance the vital performance attributes in developing a potential tennis player in Malaysia.

(a) R: Repetition

The best tennis practice drills provide repetition, match experience and enjoyment. They may also be employed to improve other performance components. Tennis drills are designed to be performed in a repetitive manner. It is proven as discussed earlier that only practice drills performed with high intensity and purpose will

result in better performance in tennis. Repetition is an important element in developing and improving any tennis skill. Players need to practice the drills and skills until they feel comfortable with them (Peterson, 2010). In conjunction with the RAHIM training principle, it indicates repetition as a vital element to enhance potential of successful tennis player as in order to improve tennis game drills that can be practiced repeatedly which some of the drills will test the player"s accuracy and identify sheer skill. After all, repetition is the key to excellence in improving tennis skills. As such repetition element is an important characteristic that must be emphasized in any tennis intervention program.

(b) A: Attitude

Tennis is a game of skill and heart. A professional tennis player needs to have ample quality of both. Positive attitude is directly related to self-confidence. Most sport psychologists agree that attitude plays a major role in the establishment of long- and short-term goals. The more positive the athlete's attitude, the more likely he or she is of achieving these goals. All athletes are physically limited to some extent, but their attitude can enhance their chances for success. Coaches must strive to provide positive experiences for their athletes. The great majority of successful athletes have very positive attitudes. In understanding the predicament of attitude, it is actually different with psychological control of the players. This situation is clearly mentioned by Pescetti (2003), that if a player is exhibiting stubbornness to falter, he or she is demonstrating strong character. The athlete is also showing an incredible display of self-confidence to keep pushing, even if the odds are mounting in their opponents favour. A coach has to make efforts in creating the right atmosphere and attitude from the beginning in the training of a player for achieving maximum performance

(Kawaljeet, 2009). In the RAHIM training model, coaches must have skills in assessing the right attitude to create a stable characteristic of tennis players.

(c) H: High Intensity

The RAHIM training principle indicates the importance of high intensity as crucial factors in determining the right method of training as most of the endurance athletes use the high-intensity training to prepare for competitions (Paton & Hopkins, 2004). A game of tennis is characterized by multiple high intensity efforts interspersed with variable periods of recovery. In terms of energy production, the high-intensity exercise periods are important. Thus, it is clear that the amount of high-intensity exercise separates the elite players from the players of a lower standard. Based on the analysis of the game, it is clear that the training of elite players should focus on improving their ability to perform intense exercise and to recover rapidly from periods of high-intensity exercise. This is in accordance with more studies which show that performance can be maintained and improved by reducing the amount of low-intensity training and keeping a sufficient amount of high-intensity training (Mujika 1998; Shepley et al., 1992).

(d) I: Independence

The development of self-independence in tennis player must be one of the primary goals in training. As in tennis, a player‟s ability to assess match situations and make positive decisions is important for successful player development. A player‟s self-independence is highly inter-related to his or her level of self-confidence and it should be developed at the beginning stage of a player‟s involvement in the game. It is important for the development of the players that they are regularly given responsibilities by the coach such as to lead the group in the warm up; to demonstrate

something to the group and so on. By giving them leadership tasks to perform, the player will begin to feel independent and be responsible which in turn will lead to improvement in their self-confidence. This will encourage players to develop their independence and increase their self-confidence. This is a characteristic that coaches are trying to develop in the end, a strong and independent player with a clear vision of his or her goals, plans and abilities. By creating the culture of excellence which fosters the successful performance, coaches will help to develop the independence of players in making decision and the skill to handle difficult situations with confidence.

(e) M: Movement

Schönborn (1998) states that the whole movement potential of a tennis player is determined by the individual's conditioning and coordination abilities and that is why these abilities must be continually integrated into tennis technique. It has been stated repeatedly in the tennis literature that tennis places demands on the ability of a player to move quickly in all directions, change directions often, stop and start, while maintaining balance and control to hit the ball effectively. In addition, to enhance performance, players have to be in the correct position to provide a solid platform from which to hit the ball. This requires good agility, speed and balance. In tennis, the preparatory movement before such a quick change of direction is known as the "split step" (Roetert & Groppel, 2001). Since tennis is an open skill sport, the technique of movement needs to be developed and refined, such as the ability to sprint, change direction and recovery. In a practical standpoint of coaching an athlete to move better during tennis matches, the training should be in a multitude of movement patterns and similar to actual situation during tennis play in order to optimize performance.

Efforts should be made to further advance the method of training in the quest to enhance the tennis performance. Although the Easy Five was shown in this study to have a significant impact on the performance enhancement of junior tennis players, other factors remain as integral parts of tennis performance development facets. It is recommended that more in-depth research will be conducted in order to explore the potentials of junior tennis players in competitions. Thereby, future tennis development programs may be structured around more scientifically based research in order to optimize the potential of aspiring Malaysian junior tennis players.

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