International Tennis Federation

COACHING & SPORT SCIENCE REVIEW

The Official Coaching and Sport Science Publication of the International Tennis Federation

Editorial

Welcome to issue 38 of the ITF Coaching and Sport Science Review, which is the first edition for 2006. This edition contains an interesting research article about testing tennis specific endurance as well as a review article on current endurance training methods. The additional articles in this issue cover topics such as psychology, teaching methodology and travelling on the NEC Wheelchair circuit.

In the previous months much work has been completed to prepare more online eLearning presentations. There are now 13 presentations available free to view on the ITF Coaching Weblet with the most recent editions being:

- Momentum and Match Flow in Tennis by Alistair Higham
- Tennis Racquets by Professor Rod Cross
- Making Tennis Easier for Starter Adults by Mark Tennant
- Moment of Inertia in Tennis by Professor Bruce Elliott
- ITF Juniors Overview 2005 by Luca Santilli

Additionally, work has begun on the preparation of eLearning presentations in Spanish. This section of the ITF Coaching weblet will be launched in the coming months and will feature presentations from some of Spain's best tennis coaches, sports psychologists, physiotherapists and members of the Spanish Tennis Federation Coaches Education department. We also hope to be in a position to prepare some presentations in French before the end of 2006.

This year the 4th biennial ITF Regional Coaches Conferences, formerly known as Regional Coaches Workshops, will be held. It has been confirmed that the 4th ITF Central American and Caribbean Regional Coaches Conference which is being organised in conjunction with COTECC, the Federación Panameña de Tenis and Olympic Solidarity, will be held in Panama from September 10 - 16. It has also been confirmed that the 11th ITF South American Regional Coaches Conference, which is being organised in conjunction with COSAT, the Federación Colombiana de Tenis and Olympic Solidarity, will be in Barranquilla, Colombia from November 12 - 18. We hope to be in a position to announce the date and venue of the African and Asian Regional Coaches Conferences shortly. For the latest information on all the ITF Regional Coaches Conferences please visit the ITF Coaching homepage, www.itftennis.com/coaching/.

Mark Tennant with participants from the "Play Tennis" course, in South Africa.

The 3rd ITF Level 3 Coaches Course will be held in Europe later this year. This course will be for coaches primarily from Eastern European Federations and as more details are confirmed they will be available on the ITF Coaching Weblet. Tennis Europe, in conjunction with the ITF and the Swedish Tennis Federation, will stage the Tennis Europe Coaches Symposium in Stockholm from October 11 - 15. More information about the symposium can be found on the Tennis Europe website: www.tenniseurope.org.

A new practical 4-day "Play Tennis" course and manual has been written for coaches working with starter players. This course encourages the use of game based practices and effective organisation and rotation of players to give them stimulating sessions involving playing the game. This course was piloted in South Africa in November 2005, and is now available for use by all nations in 2006.

Finally, we hope you enjoy edition 38 of the ITF Coaching and Sport Science Review.

Dave Miley
Executive Director,
Tennis Development

Miguel Crespo
Research Officer,
Tennis Development/Coaching

Patrick Mclnerney
Assistant Research Officer,
Tennis Development/Coaching

Contents

A New Approach for Training Tennis Endurance

By Mark Kovacs (The University of Alabama, Tuscaloosa, USA)

INTRODUCTION

Tennis players regularly compete in matches that last longer than two hours, which predominantly involve high intensity short duration bouts combined with short rest periods. The duration of work and rest is highly variable and the work periods involve the use of many muscle groups. For these reasons, training for tennis is complex and requires that coaches develop more specialised training programmes for tennis players.

When designing training programmes, it is important to train the energy systems that predominate during match play. Therefore the design of energy system-specific (ESS) training for tennis is required, which should be based on the current literature available on the energy requirements of tennis. A common problem that still occurs with regard to training specificity is the method by which tennis endurance, aerobic capabilities, is developed. Developing tennis endurance is usually the major focus during the off-season or pre-season (general preparatory/specific preparatory) periods of training. Traditional slow aerobic conditioning or even long interval training sessions are still present in many tennis conditioning programmes. Examples of this include running multiple 400 meter sprints on a running track or running repeat miles to build aerobic capabilities or even increase lactate tolerance, but the question that needs to be answered is: How specific is that to the sport of tennis?

In order to design tennis specific programmes, it is important to understand the nature of tennis. Although long distance continuous aerobic routines, such as a 30 minute to 1 hour run, develop aerobic capabilities this may not be the most appropriate method of training for tennis players, as it does not match the physiological requirements of tennis match play. Aerobic capabilities still need to be trained as the majority of ATP (energy) regeneration is performed aerobically. Therefore, it is my contention that short sprint/interval training would be a more tennis specific method of training if the workload could replicate match play (i.e. work/rest intervals).

Tennis players regularly compete in matches that last longer than two hours, which predominantly involve high intensity short duration bouts combined with short rest periods. Therefore, when designing training programmes, it is important to train the energy systems that predominate during match play.

WORK/REST ANALYSIS

A good method to non-invasively determine the requirements of tennis match play is through a work/rest analysis. The results from previous studies analysing work/rest intervals in tennis have varied markedly depending on the playing surface, level of competition and gender. Therefore, if time and resources permit it is advisable to complete a work/rest analysis for each athlete to facilitate the production of an individualised training programme. Understandably, this is not always feasible. Hence, a brief review of the literature available on work/rest intervals in tennis is presented below.

In the majority of studies the average point length is less than 15 seconds (Chandler, 1991; Deutsch, Deutsch, & Douglas, 1988; Elliott, Dawson, & Pyke, 1985; König et al., 2001; Kovacs, Strecker, Chandler, Smith, & Pascoe, 2004; Richers, 1995). An analysis conducted by our research group compared the final of the 1988 and 2003 U.S. Open men's singles. It was interesting to note that the average point length has decreased by over 50 percent in the last 15 years. The time of work for each point decreased from 12.2 seconds in 1988 to 5.99 seconds in 2003. Furthermore, the average rest between points also decreased by approximately 50 percent when compared to 1988 to 15.18 seconds in 2003. A statistic which is potentially more important is that 93 percent of all points lasted less than 15 seconds (Kovacs et al., 2004). Therefore, if coaches are using old training guidelines from outdated data, they may think they are designing tennis specific programmes, however without using current work/rest data these programmes will be inefficient for developing the endurance requirements of the current tennis athlete.

WORK/REST RATIO

The aforementioned data lead in the next important piece of information required when designing physical conditioning programmes for tennis players - the

work/rest ratio. The currently published data reveals that during games for every second of work performed there is between 2.3 - 3.27 seconds of rest (Chandler, 1991; Yoneyama, Watanabe, & Oda, 1999). Therefore, if a point lasted five seconds then the approximate rest period would be 15 seconds. Data published on the work/rest ratio for an entire match, which includes the rest between games and changeovers, ranges from 2.9 - 4.73 seconds of rest for every second of work performed (Elliott et al., 1985; Kovacs et al., 2004).

CURRENT ERRORS IN PROGRAMME DESIGN FOR TENNIS

This data provided highlights how short the time of each point is during tennis match play. These findings, although important, are rarely used when designing physical conditioning programmes for tennis players. Until now too much emphasis has been placed on traditional aerobic training methods such as five and eight kilometre runs or lactate producing interval training in the form of one to two minute sprints (400 - 800 meter sprints). Furthermore, it has been shown that plasma lactate levels do not rise during high level tennis competition (Bergeron et al., 1991), which would suggest that training which involves large increases in lactate (one to two minute sprints) would not be beneficial and are in fact ill-advised for tennis players.

CONCLUSION

The purpose of this article is not to provide examples of different court drills, but to present ideas on how to incorporate your current drills and movement patterns in to a scientifically and physiologically based tennis conditioning programme. Recommendations that should be followed when designing tennis specific training programmes are as follows:

- It is beneficial to maintain physical conditioning intensity equal to or greater than match intensity.
- The large majority of work should take less than 15 seconds to complete.
- Work should not exceed 45 seconds without an appropriate rest interval.
- Work/rest ratio should be comparable to that of match play. An acceptable range is between 2 - 4 seconds of rest for every second of work.
- After every 10 - 15 repetitions, a longer rest period (to simulate rest during games) should be taken.

These recommendations are for energy system development specifically for tennis. They should not be used when focusing on speed development or high intensity agility.

REFERENCES

Bergeron, M. F., Maresh, C. M., Kraemer, W. J., Abraham, A., Conroy, B., & Gabaree, C. (1991). Tennis: a physiological profile during match play. International Journal of Sports Medicine, 12(5), 474-479.

Chandler, T. J. (1991). Work/rest intervals in world class tennis. Tennis Pro, 3, 4.

Deutsch, E., Deutsch, S. L., & Douglas, P. S. (1988). Exercise training for competitive tennis. Clinics in Sports Medicine, 7(2), 417-427.

Elliott, B., Dawson, B., & Pyke, F. (1985). The energetics of singles tennis. Journal of Human Movement Studies, 11, 11-20.

König, D., Huonker, M., Schmid, A., Halle, M., Berg, A., & Keul, J. (2001). Cardiovascular, metabolic, and hormonal parameters in professional tennis players. Medicine & Science in Sports & Exercise, 33(4), 654-658.

Kovacs, M. S., Strecker, E., Chandler, W. B., Smith, J. W., & Pascoe, D. D. (2004). Time analysis of work/rest intervals in men's professional tennis. Paper presented at the Southeastern American College of Sports Medicine Annual Meeting, Atlanta, GA.

Richers, T. A. (1995). Time-motion analysis of the energy systems in elite and competitive singles tennis. Journal of Human Movement Studies, 28, 73-86.

Yoneyama, F., Watanabe, H., & Oda, Y. (1999). Game analysis of in-play-time and out-of-play-time in the Davis Cup. Paper presented at the 5th IOC World Congress on Sport Sciences, Sydney, Australia.

Look and Listen before You Leap: Keys to Effective Communications with Players

By Dr. Janet Young (Australia)

"One of the keys to successful endeavours is the ability to communicate effectively. This means being able to listen carefully, help clarify shared values, identify a common vision and focus on resources to accomplish a goal" (Linda Bunker, Scholar)

Imagine one of your players is going to an Award night and will be talking about you as their coach. What would you like your player to say about you as a coach? While the response to this question will inevitably vary for each coach, it is likely that most coaches will nominate that they would like to be recognised as a "good communicator", a person who knows what to say, when and how to say it and what not to say.

The following guidelines and tips for coaches to consider in developing and fostering effective, open and harmonious communications with players were created after observing many coaches work with national and international players, and by drawing on my own experiences as a coach and former professional player.

GUIDELINES TO IMPROVED COMMUNICATION

- Effective communication is a 2-way process (i.e. it involves phases or steps and a shared understanding between 2 or more individuals).
- Effective communication between coach and player addresses 3 integrated issues; What, Why and How - what the player is to do, why they should do so, and how they should do it.
- Effective communication generally stems from a coach/player relationship based on respect and trust (rather than criticism and control). Remember that comments to players need not be judgemental. Coaches should acknowledge a player's strengths, achievements and efforts (thereby facilitating learning whereas judgement generally interferes).
- The appropriate use of non-verbal cues (e.g. hand and body movement, voice tone, and gestures) can greatly enhance effective communication. Use these powerful tools wisely! Also, the ability to "read" a player's non-verbal cues/body language can be invaluable in understanding your player.
- Players should know that coaches genuinely "care" about them as people. Coaches therefore need to be concerned about the person as well as the player (e.g. being able to recall what a player told you in a previous discussion is a good way to show the player that you really listen and care).

- All the ideas, theories, techniques and knowledge the coach has will be ineffective if you can not make them relevant, practical and meaningful to the individual.
- It is possible that a player can tell you something, ask that you keep it confidential, and yet unconsciously want you to take some action (that may be why they tell you!). In some situations coaches will have a duty of care (to that player and others) to act.
- There will be times when you must be willing to honestly tell a player what you think (e.g. when a player is not putting in the effort required to achieve their goal). The challenge here is for the coach to communicate respectfully and tactfully.

TIPS FOR IMPROVED COMMUNICATIONS

- Be a good listener - listen to what a player wants, to what works for them and to their suggestions. Does the player feel they are the only or most important person in the world when interacting with you?
- Take the time to get to know each individual - what does a player bring to a situation (e.g. age, experience, attitude) that allows you to see it "through the eyes" of that player.
- Take a case-by-case approach - not only is each player different but the same player can react to a similar situation in different ways over time. Be aware that players are motivated to play for different reasons (e.g. to be the best they can, to win Grand Slams, to play against the best in the world, and/or to play Davis or Fed Cup) and that these reasons may change over time.
- Gain an awareness of what you bring to each situation (e.g. your beliefs, experiences and goals). Be aware that you create the "coaching climate" such that the criteria for a player's success can be winning and/or getting better and improving one's game. This should be tailored to each individual and continually monitored.
- Don't rely on the "my door is always open" approach with your players - you must also go out and find them to discuss how things are going or if there are issues to address.
- Use positive terminology - e.g. instead of talking about "choking" rephrase it in terms of being tough and determined to find a way to fight back.
- Keep it simple - use words and terms understood by the player.
- Use non-verbal cues to appropriately complement what you want to convey.
- Use open-ended questions - this facilitates understanding a player's feelings, opinion or problem because such questions require more than just a 'yes' or 'no' answer. Open-ended questions usually begin with what, how, could or would, e.g. "How would you like me to help you?" or "What do you have to achieve this lesson?"
- Use paraphrasing to show a player you understand what they are saying:

Player - "I don't know what to do. I keep losing first round matches even though I am playing against girls I should beat. I feel like my tennis is going backwards, yet I am putting in more and more hours on the court. I am getting frustrated".

Coach's Response - "You are working very hard at your tennis yet not winning matches you feel you should. Naturally you are feeling discouraged".

- Avoid "communication blockers/ blunders" as these tend to negate the rapport you have with a player, invalidate a player's feelings and imply they are wrong, inferior or unworthy. For example:
  - Ordering, commanding: "You must get your serve in."
  - Warning: "You had better not lose to this player."
  - Criticising, disagreeing: "You are wrong to get another partner"; "How could you possibly think that was going to help your tennis!"
  - Berating: "You're acting like a 2-year old brat", "You shouldn't feel like that."
- Give and get feedback - Short, Simple, Constructive, Immediate and Direct feedback tends to be most effective and accelerates the learning process.

CONCLUSION

Given there will be numerous distractions and obstacles on the road to excellence, coaches play a vital role in guiding players. To do this successfully, coaches need to communicate to players with sensitivity, respect and honesty. This requires taking the time to get to know a player, listening to them and then thinking before you set the direction for that player in what you say (or choose not to say). Remember there are different "coaching styles" but all "good coaches" are effective communicators!

During match play communication with the player should always be positive. This includes maintaining positive body language when a player is losing or not playing their best.

Analysis of Parent-Player Relationships and the Role of the Coach

By Catherine Delforge (PhD in Sport Sciences and mental trainer, CRESS laboratory, France)

INTRODUCTION

Parents play an important role in their children's progress in sport. This is illustrated in tennis through the path taken by champions such as the Williams sisters, Maria Sharapova and Martina Hingis. These players have 'extraordinary relationships' with their ever-present parents. Unfortunately, oftentimes at a local, regional and junior level, parental behaviour is a hindrance rather than a help to the child's progress.

REVIEW OF CURRENT RESEARCH

The purpose of this article is to review and extend the knowledge of parent-player relationships in order to help the athletic and personal development of tennis players. The below table summarises results from; scientific research findings, studies based on parent-athlete relationship questionnaires, discussions with coaches, and case studies.

Obviously, this 'bipolar' list represents an ideal classification/behaviour model with regard to parental behaviour, however it must be remembered that there are many exceptions to the norm or ideal that still result in success. The case of some more recent female tennis champions is an illustration of this fact. Furthermore, each parent-player relationship is unique and there are many factors which influence this, including:

- The age and personality of both the player and parent.
- The family type.
- The social background.

Favourable Parental Behaviours		Unfavourable Parental Behaviours
• Showing an interest; emotional, financial and material investment; availability; organisation of family life; transport; nutrition. • Knowledge of the competitive sport and tennis world; being a role model; introducing the child to tennis. • Introducing the child to a variety of sports in the beginning; sharing other activities. • Support; encouragement; comfort; trust. • Being a motivator, a guide; being demanding. • Sacrifices (hobbies, holidays, money, etc.). • Putting results in perspective; playing down the importance of competition and defeat; avoiding a focus on rankings; transmitting values (such as fighting spirit, rigour, attention to detail, respect, hard work, discipline, fair play, good behaviour during matches, etc.); being objective; being honest about the child's level and the importance of sport, etc. • Moderating role of one parent between the child and the other, more involved parent. • Establishing a dialogue; decisions must be child-driven; maintaining positive communication; being attentive to the child's needs, and paying attention to his fatigue, burnout risks and his experience of competition. • Setting realistic goals; emphasise the importance of play and enjoyment at first, the notion of improvement vs. results. • Developing the child's independence and autonomy. • Being present during matches to show support; presence must be neutral, discreet and impassive. • Showing respect for players and other parents, tournament organisers, etc. • Giving advice and analysing matches (provided parents are knowledgeable about tennis) when emotions have cooled down; being positive; drawing lessons from defeats; teaching the child to think so that they can find their own solutions. • With the coach: showing an interest for their feedback; being open to their advice; showing trust and respect; establishing a dialogue; collaborating with them; knowing how to entrust your child and delegate tasks.	Variable Line Not To Be Crossed	• Being uninvolved; showing no interest; lack of availability, etc. • Being ever-present, omnipotent, being intrusive; being overprotective. • Ignorance of competition. • Focusing family activities on the tennis activities of the child; excessive purchases with no contribution from the child; tennis is the only interest; early school dropout. • Forcing the child to play many matches, to participate in competitions; putting pressure on them without taking their goals into account; misunderstanding the child's reactions. • No parental guidance; transmission of values that contradict the ethics of sport; acceptance of bad behaviour. • Verbal and physical violence in general. • Making accusations; making the child feel guilty; criticising; being sarcastic; being aggressive; being extremely demanding; giving too much praise; praising abilities and results; alternating excessive praise with ridicule; making comparisons with other children; refusing to accept defeat or always making excuses for the child. • Projecting their own desires and motivations onto the child; idealisation. • Lacking ambition; having too much ambition; overrating the child's level; emphasise the importance of results; losing perspective; connecting their behaviour and love for the child to their results; reward/punishment system. • Not letting the adolescent become more independent; interfering with their decisions. • Parent-child conflicts; mother-father conflicts caused by tennis. • Disruptive behaviour during matches; making interventions, being demonstrative. • Making analyses right at the end of matches; only seeing errors and negative sides; giving advice that contradicts that of the coach. • With the coach: interfering, being critical, lack of communication, conflicts.

Table 1. *A 'bipolar' list that represents an ideal classification/behaviour model with regard to parental behaviour (*Côté*, 1999; Delforge, 2003; Salmela & Fournier, 2004).*

PRACTICAL IMPLICATIONS FOR COACHES

Firstly, coaches should remember that it is impossible to generalise and/or predict the evolution of an athlete or of the child-parent relationship. However, it is important to be aware of the parent-player relationship in an attempt to ensure it is a positive one that does not involve any abuse, verbal, mental or physical.

As demonstrated in Table 1 there is a big difference and a line not to cross between necessary and favourable parental involvement and over-involvement accompanied by unfavourable behaviour. If unfavourable behaviour is continuous it can have long-term negative effects on the child.

At some point, most coaches would have witnessed this type of clearly unfavourable and potentially abusive behaviour. Oftentimes, these situations exist as soon as children start playing competitive tennis. As years go by and children improve, unfavourable parental behaviour generally tends to intensify.

Provided coaches are aware of what is classified as unfavourable parental behaviour (Table 1), they will be better equipped to see and to try decrease the occurrence of such behaviour. Many coaches are occasionally tempted to exclude parents who are being 'disruptive' or display unfavourable behaviour. Instead of this, coaches should try to explain and give examples of this behaviour, as sometimes it can be enough to open the eyes of parents as to the impact of their actions and words. Generally, parents do what they feel is best for their children and may not actually realise that they are making 'mistakes'. Furthermore, they are without a doubt the ones who know their children best, but oftentimes they do not necessarily know how to provide an optimal learning environment. Therefore, they need to be informed and guided. To achieve this, the coach has to establish an open and honest relationship with the parents, otherwise they will not be willing to listen nor modify their behaviour patterns.

During previous investigations, we met some parents who were actually seeking advice. This is quite often a rare occurrence. Therefore, in the situation that the coach finds they are talking to a 'brick wall' the coach should be careful. Because, if no communication is possible, there is a chance that the parent will become stubborn and decide to withdraw their child from training rather than listen to things they will not accept. In this case, it is advisable to seek the assistance of a third party (such as a sports psychologist).

CONCLUSION

The coach, while helping develop a harmonious parent-player relationship should also remember that a good parent-coach relationship will also help create a favourable environment for the child's development. In order to maintain a positive relationship with parents, it is essential to explain decisions, encourage dialogue and build mutual trust.

Finally, it is important for the coach to listen to the player. The coach will not always know what is really going on at home, so they should help the child understand the motivation and behaviour of their parents.

REFERENCES

Côté, J. (1999). The influence of the family in the development of talent in sport. The Sport Psychologist, 13, 395-417.

Delforge, C. (2003). Analyse des rôles et comportements des parents et de leurs conséquences pour les joueurs de tennis. Unpublished PhD thesis, Université de Reims.

Salmela, J., & Fournier, J. (2004). Psychologie du sport : Les familles et le sport. Revue STAPS, 64.

The Invisible Technique: Two Seconds Decide the Result

By Josef Brabenec (Former Canadian National Coach) and Svatopluk Stojan (Former Swiss National Coach)

INTRODUCTION

Why invisible technique? Because the human eye is unable to see, or register, the contact of a fast approaching tennis ball with the strings of the racquet. This "moment of contact" lasts only 4 milliseconds (0.004 seconds). Considering that a player executes approximately 500 strokes in a match, the ball is actually only in contact with the racquet for a total of 2 seconds. Those 2 seconds, which the ball is in contact with the strings, in our opinion decides the result of the match however; the player will not see a single one!

MOMENT OF CONTACT

It is well known that the decisive part of the stroke - the "moment of contact" - is produced "blindly" as a result of preconditioned optical impulses. As soon as the opponent hits the ball, optical impulses are sent from the eyes of the receiving player to their brain, which automatically evaluates all the variables related to the flight path of the ball (speed, direction, depth etc.) and determines the contact point for well before the actual contact occurs. Based on this information a player initiates the necessary footwork, body positioning and movement of the arm and racquet to hit the ball at the pre-selected contact point. More simply, we describe this action as "eye-hand (racquet) co-ordination". It is also known, that the co-ordination of correct movements is the most important element of a stroke's effectiveness.

Historically, coaches and players have been paying attention in training or during the learning process exclusively to the visible elements of the stroke; backswing, forward swing and follow through. These elements are where most corrections and improvements are typically made, but the real efficiency of a stroke depends strictly on the moment of contact/contact point, which is to all of us invisible.

Several factors of this invisible moment of contact virtually decide the effectiveness of each and every individual stroke:

1. The speed of the racquet head and the speed of the ball at the moment of contact (influences the velocity of the stroke)
2. The path of the racquet head and of the ball at the moment of contact (influences the spin and depth)
3. The angle of the racquet head at the moment of contact (influences the direction and placement)
4. The grip firmness at the moment of contact (influences the speed and the control)
5. The placement of the ball on the racquet head at the moment of contact (influences the speed, the pace and the control)
6. The summation of forces resulting from the movement of the body and the swing of the racquet at the moment of contact (the angular and linear momentum influences the power and acceleration of the stroke)

The common denominator of these 6 factors is the "moment of contact", which neither coach nor player can see nor register. However, this contact of the racquet strings with the ball, which lasts a fraction of a second and covers only 10 centimeters of the return flight of the ball, almost single-handedly decides the fate of the stroke.

Common stroke deficiencies

We will now discuss some commonly known stroke deficiencies such as: direction,

placement and speed in relation to the moment of contact. Given that players hit approximately 500 strokes per match, this requires them to perceive 500 times, evaluate the flight of the ball, position of the opposition etc. 500 times, make 500 decisions and execute 500 times. Unnoticeable, to the human eye, a slight change in the angle of the racquet head at the moment of contact will produce a placement error by a couple of meters on the opponent's side of the court. If the ball makes contact with strings 5 cm off centre, the stroke will lose 30% of its intended speed. If the racquet head contacts the ball out of the hitting zone which is 30 cm long, the stroke will be either short or long. Within this hitting zone or working racquet head zone, which is invisible to the human eye, there are an infinite number of contact points giving to each stroke a different length, placement, speed and direction. The optimal contact point for a groundstroke is located approximately 20 cm in front of the front hip. With regard to the optimal contact point great players succeed in hitting most of their strokes there. Therefore, they are great and all the rest of us are only good or average.

REACTION TIME

Another "invisible factor" that should be considered in tennis match play is reaction time. The mean reaction time of the average person is 0.2 seconds. Oftentimes, more so in doubles, players get involved in very fast exchanges at the net. They successfully return 2 or 3 amazing shots from a very close distance without being able to judge the flight of the ball or to select their response consciously. This occurs sometimes even at a recreational level, that an intermediate player returns such "miraculous" shot. This is often spoken about as a player having "fast hands".

We believe that this phenomenon of "fast hands" (a stroke produced without conscious thought) confirms that the human brain is able to determine the direction and the speed of the opponent's shot instantly when the opponent's racquet head has contacted the ball (hearing the sound helps). This is what makes the receiving player put their racquet in the correct place to return the ball. It must be remembered that these are not premeditated shots, they just happen as a result of instinctive reactions which precede conscious thought. We have also discovered that instinctive reaction is most often correct, proving that many efficient strokes are produced only as a result of the instant analytical information sent from the brain to the muscles. These instinctive actions or reactions are, again based on an optical impulse.

VISUAL COMPONENTS OF STROKE PRODUCTION

The backswing or stroke preparation, which is the visible part of the stroke, can increase or decrease the timing and co-ordination with regard to the optimal contact point. Having a good stroke preparation, will increase the chance of making contact at the optimal contact point and achieving the desired result with regard to speed and placement of the stroke. To achieve the required depth the racquet head has to be swung through the hitting point with an effective speed. After the ball is hit, the stroke reaches the follow through, which is the natural ending of the whole striking action, but it has no bearing on speed, direction or placement of the stroke, because the ball has already left the racquet.

PRACTICAL IMPLICATIONS FOR COACHES

Having spoken on some of the more visible elements of tennis play it may seem impossible to learn how to play tennis. However, reality tells us otherwise that humans are capable of learning the necessary movements based on very fast perception, judgement, decision making and response/stroke production abilities. The latter two, decision making and response/stroke production, are truly amazing abilities that tennis players have as every oncoming ball is different with regard to speed, depth, placement, spin, direction and court positioning of the players. Hence, every tennis player faces and creates new situations with each shot and is therefore more or less a creative artist in their own right.

This has been shown to be true as we may often see people playing with an awkward style (Jim Courier, Karsten Braasch, Monica Seles, Fabrice Santoro, Byron Black, etc.) but with amazing stroke efficiency. This amazing stroke efficiency results from excellent eye hand co-ordination and an optimal contact point. It can be said that they get the racquet head in the right place at the right time in their own personal way. Contrary to this, there are thousands of players with picture perfect stroke technique who have lots of problems hitting the ball in the court because of poor timing which leads to a less then optimal contact point.

An intelligent and experienced coach will recognise when players have efficient strokes even if they are awkward looking and instead of changing their technique will help them optimise their stroke efficiency. In order to achieve optimal stroke efficiency there are two factors which play a major role:

1. The optimal contact point/moment of contact of the stroke
2. The co-ordination resulting in the correct timing of the stroke

In our opinion, a slightly mistimed contact point/moment of contact is the most common cause of errors and it is for this reason we will only address this issue. To constantly hit the ball in the optimal contact point is impossible. Great players do it more often than all the others and that is the main reason why they are great. This leads to the question, How we practice and improve what we do not see?

Firstly, coach and player have to accept the idea that other factors exist besides the visible movements of stroke production which have a major role on its outcome. Before all, the previously mentioned six points that decide the efficiency of a stroke should be analysed. Is there enough racquet head speed? In which direction does it travel? Is the angle of the racquet head correct? Does the player hold the grip firmly enough? Is the ball contact point located at the appropriate location on the racquet head? How the body weight is transferred at the moment of contact?

In our opinion the first thing to do, as we believe it is the most important, is to establish the ideal point of contact. This can be done simply by self-feeding i.e. dropping the ball from the extended left hand approximately 50 cm in front of the left toe. This gives us the ideal contact point for a right handed forehand stroke at approximately 20 cm in front of the left hip.

Sometimes it is even necessary for good players to re-establish this optimal hitting point which is crucial for the beginners. During the serving motion, the toss establishes the contact point: A fully extended left arm inside the court tossing the ball in a straight vertical line gives the optimal contact point about 50 cms inside the baseline. For volleys, the ideal contact point can be established by catching the ball well in front of the body.

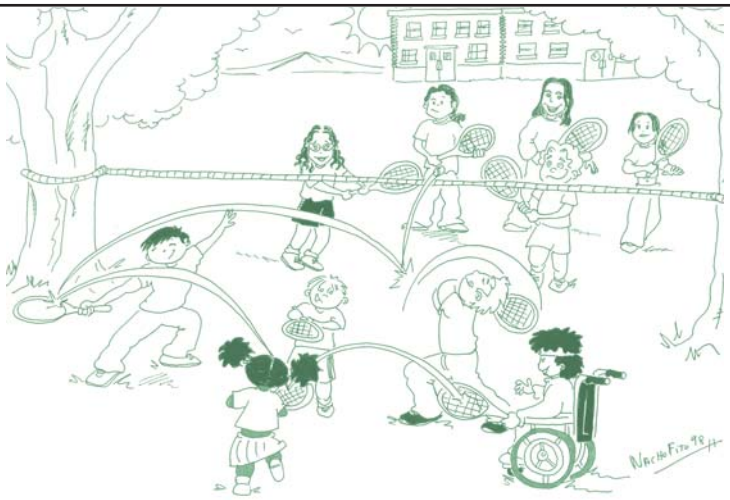
The next progression would be to hit the ball against the wall and to catch it with the left hand in front of the body at the contact point. These exercises have a great advantage as the contact point can be seen which will help your eye to establish/re-establish the ideal contact point and to register it, which in turn should help to co-ordinate movements when hitting the ball. Good timing and co-ordination are essential elements of stroke efficiency.

CONCLUSION

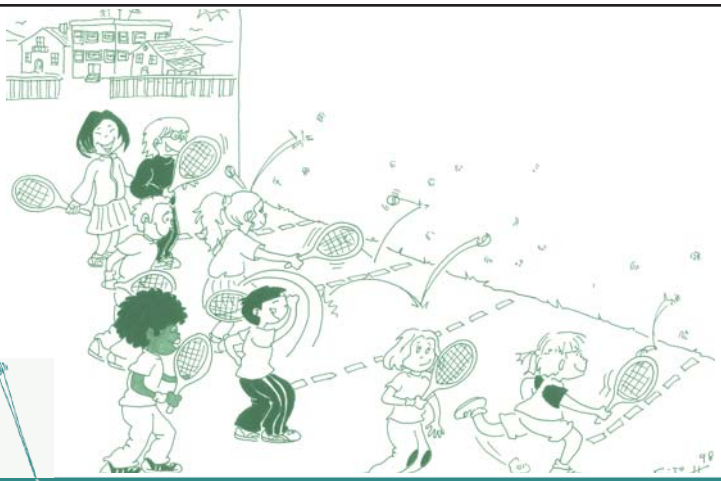
It is important for both the coach and player to recognise that there are many factors that can influence the outcome of a stroke, even some that can not be seen by the human eye. And to know that even though it can not be seen it can be trained and improved. Finally, all co-ordination, reaction and response time drills should be performed exclusively on optical impulses and never on verbal cues.

2 ONE HOUR LESSONS FOR CHILDREN 5 - 8 YRS OLD

LESSON 27	**Theme**: RECEIVING, PROPELLING, CO-OPERATING AND MOVING
Objective	To exchange a ball with a racket as often as possible over an obstacle.
Warm up	Two ball toss & catch: Students form pairs and throw and catch two balls alternating and moving towards a line. Team who reaches the line first with no mistakes wins.
Games/Exercises	Volleyball tennis: Students are divided into two teams. They hit the ball up with the racket three times per team before hitting it over the net to the other side of the court. Teams play points. Allow bounce or no bounce depending on student's level.
Variations	After the bounce, before it bounces, using both faces of the racket, etc.

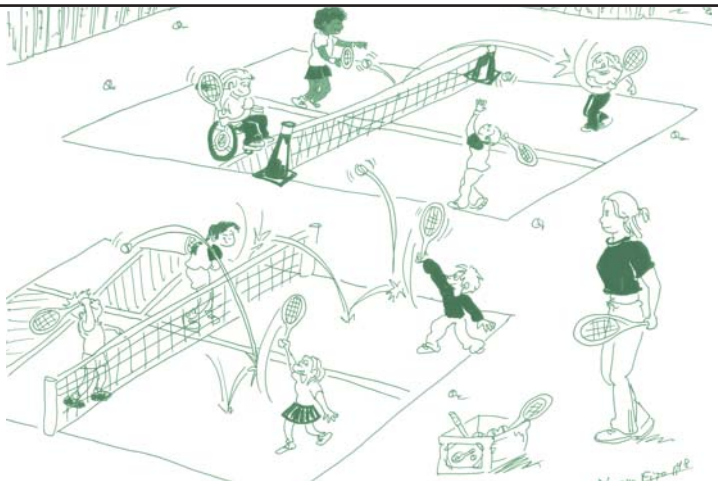


LESSON 28	**Theme**: RECEIVING, PROPELLING, CO-OPERATING AND MOVING
Objective	To exchange a ball bouncing it off the wall each partner using a racket.
Warm up	Rolling and blocking balls with racket: Students form pairs. They roll and block the ball one to another while moving and running towards a specified line.
Games/Exercises	Ground / wall bounce (Hitting to a wall contest): Students form pairs. They rally against the wall progressively increasing the distance from it. Students who make the longer rally win.
Variations	Hitting it after one bounce, in a limited amount of space, without bouncing on the floor, etc.

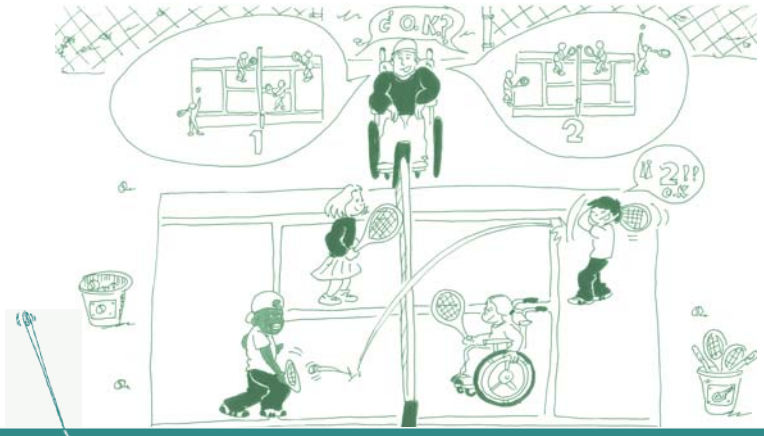


2 ONE HOUR LESSONS FOR CHILDREN 8 - 10 YRS OLD

LESSON 27	**Theme:** PROPELLING, RECEIVING AND COMPETING: DEFENDING AGAINST SHORT BALLS, WIDE BALLS AND AGAINST STUDENTS AT THE NET
Objective	To improve the defensive skills of students when attacked by short or wide balls, or by a net student.
Warm up	Long distance throw and catch contest: Students form pairs. They throw and catch the ball alternating and progressively increasing the distance between them. Ball is not allowed to bounce. Students more distant one from another win.
Games/Exercises	Moonballer: Students rally in 2's. Student A serves to a specific zone in the court, B returns the serve and runs to the net and they play the point but A has to hit lobs all the time. Students rotate positions.
Variations	Defending against wide balls, against short balls, against power balls, etc.



LESSON 28	**Theme:** TENNIS ETIQUETTE AND RULES OF TENNIS
Objective	To review with youngsters some basic rules and principles which will enhance their experience in the sport of tennis.
Warm up	Jog: Jog around for 3 minutes changing the rhythm (slower, faster, etc.).
Games/Exercises	Doubles Quiz: Students play doubles and the teacher asks questions on tennis rules and etiquette. Correct answers are 1 point, incorrect answers are 1 point for the opposite team.
Variations	Series of questions related to: basic tennis rules, tennis etiquette, meaning of good sportsmanship, etc.



Travelling on the NEC Wheelchair Tennis Tour

By Mark Bullock (ITF Wheelchair Tennis Development Officer)

Recently wheelchair tennis has started to become more 'professional' in terms of the organisation of events and the introduction of prize money. Accordingly many players are now semi-professional or professional. In saying this it must however still be remembered that there is a large difference between the prize money, accommodation and general facilities afforded to the wheelchair tour when compared to the WTA and ATP tours. Hence, the question for coaches is; are you preparing your players for the rigours of the NEC Wheelchair Tennis Tour or do you simply coach techniques and tactics and feel that the lifestyle management of your players is not your concern?

As a coach you appreciate that professionalism is not an option. It is not something you can choose to do one day and not the next, because if you did this you would not have a job. Professionalism is one of the most important things a coach can teach a player. If you teach your players how to be professionals you should be able to answer yes to the following questions, and if you can not it is something that you should introduce to your coaching. Do you educate your players to be well organised and take responsibility for their own development both on and off the court?, Do you instil in them a work ethic and positive attitude to practice that you know will be re-produced when they are travelling?, Do you encourage them to understand the impact of their diet on their performance?, Do you explain the importance of regular and sufficient sleep?, Do your players understand the importance of drinking fluids not just when on court but at all times?, Do your players follow a fitness programme?

As the sport of wheelchair tennis continues to grow in terms of participation, so to do the expectations of players with regard to tournament organisation and prize money. Along with these increases the skills required, both on and off the court, to succeed are also increasing. As more and more countries take up the sport and participation continues to grow, what is required to be a top 100 player will change and success will become much harder. It is for these reasons that a professional approach may be the difference that gets a player into the Paralympics, or the Invacare World Team Cup Squad or a victory in a National or International Championship.

This article cannot cover every aspect of a player's approach to wheelchair tennis, which for some players is their profession. However, it will outline some key areas that players must consider when playing and travelling on the NEC Tour. All factors discussed relate to the professionalism of players and while some may be similar to requirements on the ATP or WTA Tours it is important to remember that the Wheelchair Tour only began in the 1980's and that only recently has wheelchair tennis been included in the Grand Slams.

TRAVELLING

Players should drink lots of fluids whilst flying and avoid alcohol so that they remain well hydrated. They should ensure that they arrive at events early enough to get over any effects of jet lag and acclimatise to the possible differences in temperature, humidity, altitude and food. It is also vital to become familiar with the tournament surroundings so players do not panic on the first day of an event because they cannot find something they need.

It is also important to encourage younger and less experienced players to book their own flights and make enquiries about visa and vaccination requirements as this will give them a greater sense of ownership and independence, hence better preparing them for the difficulties of travel.

EQUIPMENT

Players must be educated to travel with rackets and wheelchair in excellent condition. Unlike the WTA and ATP tours there may not be a stringer at the tournament venue, furthermore repairs on wheelchairs will probably be more difficult than you would expect. Therefore players must ensure they: know how to pack their tennis wheelchairs to minimise the chances of damage in transit; carry spare tyres, inner tubes, a pump and a tool kit, and more importantly know how to change them; travel with plenty of grips and string; and know their string tension in both pounds and kilograms. It is also important to note that it is not a requirement of tournaments to provide a repair station. Many tournaments will provide such facilities but ultimately it is the player's own responsibility to ensure that their chair is 'fit for play'.

PRACTICE

This is one of the most important aspects of travelling on the tour, because when travelling overseas it is normally for an extended period of time, 4-6 weeks. Therefore it is important that when practicing at 'home' you teach players good training habits such as completing a dynamic and progressive warm-up or practicing with a purpose/goal in every session. If you can instil these habits into players it will help prepare players for training when they travel.

ENTERING TOURNAMENTS

Players should have a major say and role in planning their tournament schedules. Educating junior and less experienced players to send in their own entry forms and make enquiries about events should be a high priority for all coaches. Not only does it make the player more responsible but it takes some workload away from the coach. Players on the NEC Wheelchair Tennis Tour and their coaches should know the answers to the following questions.

- How are points allocated for the world ranking?
- What is the difference between an ITF1 and an ITF3?
- What is the difference between the Main draw and Second draw?
- How does a feed up card work?

If you could not answer all of the above questions specific information on all of the above points can be found by referring to the calendar on the ITF website: http://www.itftennis.com/wheelchair/tournaments/index.asp and in the ITF Wheelchair Tennis Handbook: http://www.itftennis.com/wheelchair/rules/wheelchairtennishandbook.asp.

THE HOTEL

The quality of hotels on the NEC Wheelchair Tennis Tour can vary greatly. Things such as washing clothes and making telephone calls, etc. can become a time, money and energy consuming process, especially when some hotels do not have internet access. Therefore, the coach and player must investigate the hotel facilities before travelling so that all the thoughts of the player when they arrive can be focused on the tournament. Another important aspect of staying in the official tournament hotel is that players will have to share rooms. It is often best to share with a regular doubles partner or another player that a player knows quite well to avoid, differences/arguments or being woken in the middle of the night by a stranger before an important match.

'HANGING AROUND'

Travelling to international tournaments involves a lot of waiting around, in airports, in hotels and at the event itself. Therefore, it is important for coaches to talk to and educate players about how they can best use this time and avoid boredom. This will help players avoid the distractions that might prevent a player from focusing on the job in hand. Rain delays can frustrate players if they are not prepared with a strategy of what to do while they are waiting. Quite often at wheelchair tournaments there will be many games of chess played during these delays. This is a perfect game to play during these delays as it requires no physical exertion and a chess board can easily carried in a tennis bag.

DOUBLES PARTNER

As mentioned previously having a regular doubles partner can make travelling on the NEC Wheelchair Tennis Tour easier. However, if a player does not have a regular doubles partner it is important to find out who is travelling to the same tournaments and arrange a partner in advance. This helps reduce uncertainty/stress of travelling and increases a player's chance of playing with a preferred partner. This also gives players a better opportunity to develop an established and successful partnership.

The design of a wheelchair for tennis play is notably different. It facilitates the ability of players to move and turn rapidly.

LANGUAGES

Encourage younger players to learn and use languages. The 124 tournaments on the NEC Wheelchair Tennis Tour span 31 different countries and approximately 20 different languages. If younger players can learn the basics in numerous languages not only will it make life on the NEC Wheelchair Tennis Tour that bit smoother but it may also encourage them to study languages in school as they will see the benefits themselves.

THE COACH

If you get the chance to travel with one of your players it is a great experience that will increase your understanding of the standard of players, tournament facilities and the NEC Wheelchair Tennis Tour in general. Travelling also provides a great chance to learn from other players and coaches. All coaches should attend an event in their own country before travelling abroad. Travelling will also improve your understanding of some of the problems that can be encountered by the players when travelling such as delayed flights, lost passports and lost or damaged wheelchairs!

CONCLUSIONS

Things will always go wrong; however the player who is more prepared will be better equipped to deal with such situations. Before any player travels it is advisable to have a 'what if' discussion. For example, by simply talking about the following questions players should be much more prepared to handle such a situation; What if my luggage is lost?, What if my rackets are stolen?, What if my chair is damaged by an airline?. Furthermore, encourage players to discuss the Tour with more experienced players to enhance the learning process.

This article does not cover everything a player needs to consider when travelling but it will hopefully help coaches and players for life on tour. There is much more involved to competing on the NEC Wheelchair Tennis Tour than simply playing tennis. Top players need a wide range of skills and attributes to enable them to be successful. Finally the most important point of this article is to remember is 'be prepared and expect the unexpected'!

"Learner-Centred" Coaching

By Wayne Elderton (Canada)

INTRODUCTION

To help a player achieve their full potential, a coach should be "learner-centred". This means the coach works in partnership with the player to identify and achieve the player's goals (not the coach's goals, or the goals they assume, or think, the player should have).

It must be clarified that learner-centred does not mean learner-driven, because the learner does not have the experience or expertise to know what the process should look like. Therefore, the process is still driven by the coach, however there is a greater focus on the needs of the player. A learner-centred process includes:

- Giving the player a clear picture of where their current situation (awareness)
- Formulating a strategy for the player to progress towards achieving their goals at an accelerated rate (goal-setting, short-term and long-term)
- Determining what the player is willing to do to get to their goals (commitment)

Learner-centred coaching gives players more and better tools to produce results and a greater confidence in their ability to do so. Learner-centred coaching is not 'teaching' (although it may include teaching at some points). The key is in unlocking a player's ability to learn. Nobel prize-winning writer, Patrick White once said, "I forget what I was taught. I only remember what I learnt".

Before asking the question, what should I teach? Coaches must ask the question, how do people learn? Asking that question will lead down a fundamentally different path and it will set the tone for everything a coach does. Another very important factor to remember is that every individual is unique when it comes to learning. We all take in, order, and remember information in our own way. The following three 'Learning Laws' should be known by all coaches (Elderton, 2001):

1: PLAYERS REQUIRE A DESIRE TO LEARN
2: PLAYERS LEARN IN DIFFERENT WAYS
3: PLAYERS LEARN AT DIFFERENT SPEEDS

To be "Learner Centred" a coach must keep these laws in mind. Using a coaching style

that is the same for everyone, "This is how I like it" or, "Do it because I say so and I am the coach", will definitely not ensure that each player is in their optimal learning environment.

Knowing more about learning allows a coach to communicate better and speed up improvement. More importantly, knowing about learning will allow coaches to coach people (build a relationship that empowers them to achieve their goals), rather than just teaching skills.

Many coaches would say they coach in a learner-centred way. But, if you were asked what the difference is between teacher-centred or learner-centred lessons, would you know the answer? What are the main considerations? What would change in your coaching process? How does learner-centred coaching apply to the way you coach now?

MAIN CONSIDERATIONS FOR LEARNER-CENTRED COACHING

To remember all the main considerations for learner- centred coaching, we can organise them to form the acronym S.E.T.S. (Skills, Environment, Tools and Stages).

Skills in Learning

Learning tennis is a more sophisticated process than just having a coach explain how to do certain movements. There are many skills in tennis, and many ways in which they can be taught and learnt. How a coach views and handles the skills they teach can either shortcut the learning process or make it longer and unnatural. When the words "tennis skills" are said to most coaches, they think 'strokes'. However, tennis skills encompass much more and fall into two key categories (Thomas & Thomas, 1994; Schmidt & Lee, 1999):

Holistic Skills: Tennis coaches tend to get fixated on technique. However, tennis includes psychological skills (mental and emotional), physical skills, tactical skills and technical skills. To develop a complete player, a coach must help players learn the skills in all of these areas. When working on the improvement of all these skill areas it can be called, "holistic" development.

Tennis is an "Open Skill": An open skill means the technique must be adapted to the given situation. What is the use of teaching a specific series of movements, such as the traditional forehand stroke model when the technique must be adapted according to where the player is, the type of ball they receive, and if they are attacking or rallying, etc? Players must learn to read the situation (called "Perception"), decide the best response (called "Decision-making"), execute the appropriate technique, and then see if it has been successful or not (called "Feedback").

Using a Game-based Approach: Tennis is a game that one must learn to play. For beginners, the fun of tennis play can be maintained by scaling the game down to a level appropriate for the player (modifying court size, racquet size and weight and ball). Regardless of the level, if tennis is taught in realistic situations, the skills learned will transfer into match play much easier. Game-based approach means the tactics to play the game successfully must drive the development of the techniques learned. Players who learn this way develop faster than those who learn with traditional methods. This type of teaching is fundamentally different than the traditional view of tennis teaching, in which tennis was seen primarily as a technical sport that often used a 'one size fits all' stroke model (i.e. everybody should play with the same grip, have the same backswing, contact point, etc.) (Vereijken & Whiting, 1990).

A good example of how the fun of tennis play can be maintained, for beginners, by scaling the game down to a level appropriate for the player (modifying court size, racquet size and weight and ball).

The Learning Environment

A coach can help a player progress through the stages of learning more easily by creating a fun and effective learning environment. An environment that motivates players to learn includes the following elements of:

Organised: Learning increases when it is systematic. Well-planned training should clearly show the path toward improvement. Good organisation allows for good levels of activity, much variety, and a safe environment. Boring, or unsafe training decreases motivation to learn.

An Enthusiastic Coach: A coach's passion for tennis and learning can be 'caught' by students. They will often respond better to the role modelling a coach performs than the words the coach says.

This type of setting will help players enjoy the process (have fun), be stimulated, develop internal motivation, and ultimately commitment.

Tools for Learning

In addition to creating the appropriate learning environment, there are some important 'tools' a coach should use to speed up or enhance the learning process.

Cooperative Coaching Style: Players change more readily and easily if the change comes from within them (rather than it being imposed from the outside - coach). A coach can use a 'cooperative' communication style to work with the player to affect change. By using questions and encouragements the coach communicates with the player (rather than at the player). The result is an experience of 'guided discovery'. The contrast to a cooperative style is one where the coach is 'autocratic' or 'directive'. In this approach, the coach is the all-knowing dictator and the player is the 'unintelligent' student (Jones, 1982; Knight, Gunze & Feel, 1997).

Feedback: This is the most important tool a coach has to affect learning. Feedback is

reflecting a player's performance back to them. Effective feedback speeds up learning and helps build skills. If the feedback is positive, that will enhance learning even more as it reinforces good performance and encourages it to be repeated (Swinnen, Schmidt, Nicholson & Shapiro, 1990; Vickers, Livingston, Umeris & Holden, 1999).

Learning Modes: By understanding the three basic ways players take in/process information, feedback can be tailored to the needs of the individual player. The three modes of learning are:

- Visual: Processing information through the eyes
- Auditory: Processing information through the ears
- Kinesthetic: Processing information through body feelings

Everyone uses all three however they will prefer one or two and respond best if information is given in those modes.

Goal Setting: If the goal setting process is performed correctly, goals can enhance learning by describing a systematic process for development. They give a direction to help both player and coach to focus energies and effort. Players respond better when a specific direction is laid out, the appropriate level of challenge is given, and there are measurements to gauge progress.

Stages of Learning

Every player will pass through three stages of learning before they can use a new skill effectively and consistently in match play (Christina & Bjork, 1991; Cayer, 1987; Schmidt & Lee, 1999):

Stage 1: Understanding: This stage involves getting an initial intellectual and kinesthetic comprehension of the performance of the stroke. It is the process of progressing a player from "Unconscious Incompetence" (player is unaware of what they are performing) to "Conscious Incompetence" (player is aware of how to perform successfully but is unable to do it consistently).

Stage 2: Repetition: Practicing the skill over and over to 'groove' or perfect it. It can be described as the process of taking a player from "Conscious Incompetence" to "Conscious Competence" (players can only perform the stroke successfully if they are totally focused on the performance).

Stage 3: Automatic Decision Making: In this third stage the stroke is used in match play situations. This results in the player going from "Conscious Competence" to "Unconscious Competence" (player selects the correct time to use the skill in competition and performs successfully automatically).

Each stage has its own unique goals, pitfalls, and procedures. A coach must be able to recognise which stage a student is in so they can provide them with the most effective type of training. If a coach omits, or poorly develops a stage, the result will be the incomplete development of the skill.

CONCLUSION

Being learner-centred dramatically increases a coach's professionalism. It also helps the coach to constantly look for new and creative ways to help students, which is what every tennis player deserves.

REFERENCES

Elderton, W. (2001). "21st Century Coaching: Learner-centred principles for the Game-based approach", www.acecoach.com

Christina, R.W. & Bjork , R.A. (1991). Optimizing long-term retention and transfer. In Drukman, D. & R.A. Bjork (Eds.). In the mind's eye: Enhancing human performance. pg 23-25. Washington, DC: National Academy Press.

Cayer, L. (1987). The Actions Method. Presentation at the ITF Worldwide coaches Conference. Mallorca, Spain.

Jones, D. (1982). Teaching for understanding in tennis. Bulletin of Physical Education, 18 (1), 29-31.

Knight, G. W. Gunze, P. J. & Feel, P. (1997). Using questions to facilitate motor skill acquisition. Journal of Dental Education. 61, 1, 56-65.

Schmidt R.A. & Lee, T.D. (1999). Motor Control and Learning, 3rd edition. Human Kinetics, Champagne, Ill.

Swinnen, S., Schmidt, R.A. Nicholson, D.E. & Shapiro, D. C. (1990). Information feedback for skill acquisition: Instantaneous knowledge of results degrades performance. Journal of Experimental Psychology: Learning, Memory and Cognition, 16, 706-716.

Thomas, K. T. and Thomas, J.R. (1994). Developing Expertise in Sport: The relation of knowledge and performance. International Journal of Sport Psychology, 25, 295-312.

Vickers, J. N., Livigston, L.F., Umeris, S., Holden, D. (1999). Decision training: The effects of complex instruction, variable practice and reduced delayed feedback on the acquisition and transfer of a motor skill. J Sports Sci, 17, 357-367.

Vereijken, B., & Whiting, H. T. A. (1990). In Defence of Discovery Learning. Canadian Journal of Applied Sports Science, 15, 2, 99-106

Specific Incremental Test in Tennis

By Girard, O. [1], Chevalier, R. [2], Leveque, F. [1], Micallef, J.P., [1] and Millet, G.P. [3]

(1 UPRES - EA 2991, Faculty of Sport Sciences, University of Montpellier 1, France, 2 CREOPP, Faculty of Sport Sciences, France, 3 ASPIRE, Academy for Sport Excellence, Doha, Qatar)

INTRODUCTION

Physiological, technical, and tactical skills are all important to performance in racquet sports (Lee, 2003). 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 matches (König et. al., 2001). Laboratory testing is commonly used to evaluate physical fitness or characterise training effects. It might also be performed for prescribing the sub-maximal training intensities used during the aerobic training for tennis. However, during treadmill testing, the modes of exercise tests (continuous activity) often do not simulate the specific demands of tennis (intermittent activity) and therefore do not reflect the specific muscular involvement of both lower and upper limbs with respect to the stop, start and change of direction movement patterns required during tennis play (Fernandez, 2005).

AIMS OF THE STUDY

Therefore, the aims of this study were 1) to develop a specific incremental fitness test including some elements of tennis play; and 2) to compare physiological, heart rate (HR) and blood lactate concentration ([La]), and perceptual, rating of perceived exertion (RPE), responses at maximal load recorded during this field test (FT, sport specific) to those observed during an incremental treadmill test (TT, non-specific) in nine well-trained tennis players (mean: age 16.0 ± 1.6 yrs; height 179.8 ± 9.4 cm; body mass 65.3 ± 11.9 kg; training frequency 8.2 ± 3.1 $h.wk^{-1}$; ITN 4). It was hypothesised that the

physiological-perceptual responses would differ between the TT and FT due to the differences in movement patterns between running (forward running only) and playing tennis (combined use of arms and legs).

METHODS

Treadmill Testing

The TT was performed on a motorised treadmill (S 2500, Medical development, France) and consisted of an initial 3 minutes continuous workload of 9 km.h^{-1} followed by increases of 0.5 km.h^{-1} every minute (0% incline). Each stage was composed of a 45 seconds (s) running period followed by 15 seconds of active recovery during which subjects had to walk at 5 km.h^{-1}.

Field Testing

The FT consisted of repeated movement patterns replicating the tennis game, at an increasing speed on the court. Each stage consisted of seven shuttle runs, performed from a central basis to one of the six targets located around the court, alternated with 15 seconds of active recovery (Figure 1). Sets of seven rallies included two forward (offensive), three lateral (neutral) and two backward (defensive) courses performed randomly. When the subject arrived at the target, he was instructed to mime a powerful stroke as in match play before moving back to baseline after each stroke. Movement velocities and directions were controlled by visual and sound feed-backs from a PC computer. Briefly, a specific piece of software was used in order to simultaneously sound a tune (beep) and project a picture of a player moving around the target which they had to reach. These velocities and sequences of movement were calculated from data collected during official competitions (unpublished data). Test reliability of the FT was determined in four subjects performing two FT within one week.

Data Analysis

TT and FT ended with voluntary exhaustion of the subjects. At this time, [LA] and RPE responses were determined from a portable analyzer (Lactate Pro, LT-1710, Arkray, Japan) and the 15-category Borg scale, respectively. The highest values for HR over 5 seconds (S810, Polar, Kempele, Finland) during FT and TT was regarded as maximum heart rate (HRmax). Time to exhaustion (Te) in seconds was also recorded.

In both tests, three criteria were used to determine maximal efforts:

1) A final HR above 95% of the age-related predicted maximum (220 - age)
2) A final RPE › 16
3) A [LA] › 8 mmol.l^{-1}

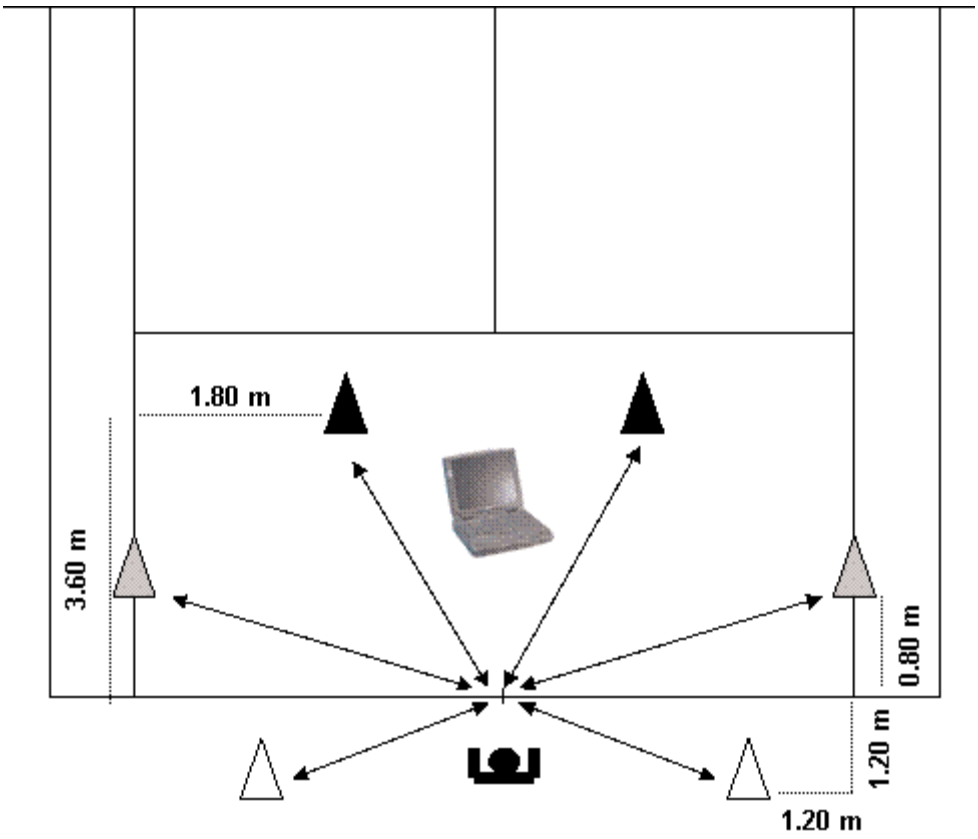


Figure 1. *Set-up of the specific incremental fitness test for tennis players. The position of forward (black cones), lateral (grey cones) and backward (white cones) targets are indicated.*

Data obtained at maximal load were compared between FT and TT, using paired-sample t-tests. P ‹ 0.05 was determined as statistically significant.

RESULTS

No difference was found in Te (1479 ± 69 vs. 1454 ± 103 s; CV = 1.2%), HRmax (193.7 ± 7.2 vs. 187.3 ± 1.5 bpm; CV = 2.1%) and RPE (17.3 ± 1.2 vs. 16.7 ± 1.5; CV = 2.8%) between two FT performed within one week (N = 4). Subjects satisfying the HR, RPE and [La] criteria for maximal effort in TT and FT were 78 vs. 89%, 89 vs. 100% and 67 vs. 89%, respectively. HR increased progressively during TT and FT and reached almost maximal levels (Figure 2). Te (1666 ± 188 vs. 1491 ± 64 s; 10.5%) and HRmax (189.9 ± 5.1 vs. 194.1 ± 7.7 bpm; 2.2%) were significantly higher (P ‹ 0.05) in TT than in FT. Mean values of [La] (2.2 ± 0.5 vs. 2.2 ± 0.6 and 10.6 ± 4.3 vs. 10.7 ± 3.0 mmol-1) and RPE (9.0 ± 2.1 vs. 8.6 ± 2.1 and 17.7 ± 1.0 vs. 18.5 ± 0.9) measured before and after exercise did not differ between TT and FT, respectively.

DISCUSSION

In ball or racquet sports like tennis, exercise testing on a treadmill (i.e. running) is not specific for the muscles involved and therefore inadequate to evaluate the specific demands of the sport. As a consequence, we designed a specific incremental fitness test for tennis players including some technical characteristics (i.e. performed on a tennis court; similar movement patterns to competition; variability in the movement direction; replication of stroke play) and compared the physiological-perceptual responses with an incremental treadmill test.

Interestingly, the load increments during TT and FT were similar as evidenced by the progressive increase in HR (Figure 2) and by the fact that rest intervals (15 s) were identical in the two tests.

The FT had a high reproducibility illustrating that this test is sensitive and valid to detect differences between players as well as seasonal changes in "tennis fitness".

In both tests, the criteria of HR, RPE and [La] were satisfied by most of subjects showing that participants were effectively exhausted after TT and FT. The mean HRmax and end-exercise [La] values showed that during the last stages of both tests players experienced an elevated cardiovascular stress and that the anaerobic energy system was highly taxed for energy restoration.

Training regimens have to be designed on the basis of the physiological data recorded during competition. In this context, it is

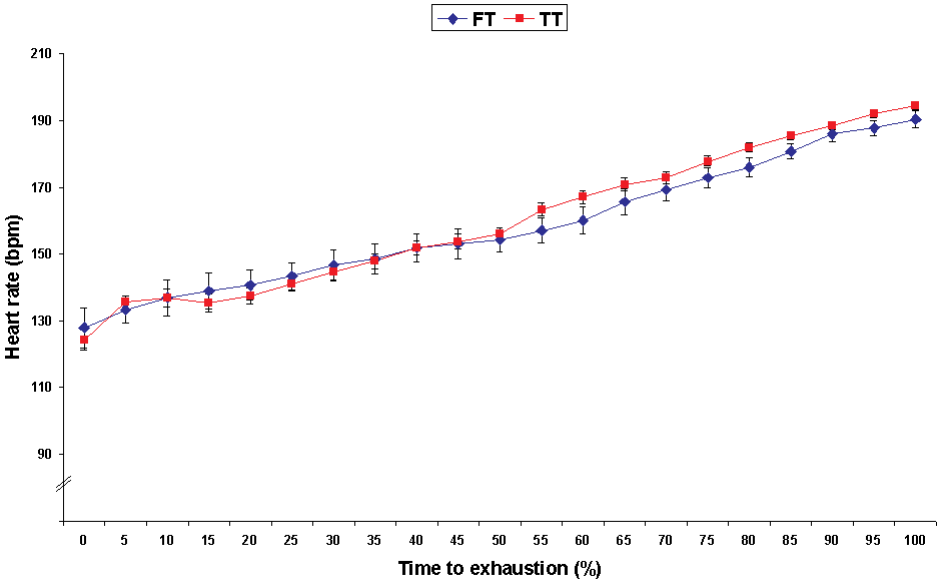


Figure 2. *Heart rate data (Mean ± SD.) recorded every 15 seconds during the incremental field test (FT) and treadmill test (TT).*

interesting to note that HR response during the last stages of TT and FT were similar to the levels observed during the intense parts of a tennis match play (190-200 bpm) (König et. al., 2001). However, HRmax values were different between TT and FT suggesting that maximal HR derived from laboratory testing is not relevant for an accurate estimate of fitness in tennis players. Although the design of the two tests was intermittent in nature it is, however, noteworthy that during the FT, players were asked to perform repeated specific movement patterns in all directions including crossover steps and the involvement of the upper arm through the replication of tennis stroke play with racquet in the hand. During the FT some demands are therefore needed like speed, coordination, flexibility, agility and positioning with relation to the ball, which may have in turn limited the achievement of a maximal performance (reduced HR and Te).

Interestingly at maximal loads [La] and RPE were similar in both tests, which differ from previous findings which reported higher [LA] values following treadmill than field testing (Smekal et. al., 1995; Smekal et. al., 2001,). A possible explanation could be the intermittent design of the present treadmill test contrasting with previous reports adopting a continuous load profile for incremental tests performed in the laboratory. Indeed, it is well established that lactate can be oxidized locally or transported from production sites to oxidative muscle fibers for subsequent oxidation during recovery periods (Brooks, 1986).

Recent efforts have been made to develop field tests in tennis to determine the exercise capacity or technical performance of athletes with acceptable accuracy under standardised conditions (Davey, Thorpe & Williams, 2002; Smekal et. al., 2000; Vergauwen, Madou & Behets, 2004). However, because these tests require either expensive equipments (specific type of ball machine, video, radar) (Vergauwen, Madou & Behets, 2004), only simulate rallies from the baseline (Smekal et. al., 2000) or do not reflect precisely the time intervals of tennis play (Davey, Thorpe & Williams, 2002), they cannot be routinely used to accurately evaluate an individual player' fitness level in a context appropriate to the game. As a consequence, the potential benefits of the proposed field test are important. First, it places a specific demand upon the player and would therefore be an appropriate test to be included into a training routine. Secondly, it involves movement patterns that are more specific to training and competition which has the potential to increase players' motivation as they have to bit the ball. Again, the progressive increase in load profile appears to be a strong point. This test may also be beneficial when the weekly training time is limited.

Finally, this test can be combined with the training of sport-specific technical elements and easily administrated in players of various standards as it requires limited equipment (6 cones, a measuring tape and portable PC including the software of the test). Therefore, it can be routinely used to indicate an alteration or improvement in the player's physical performance with maintaining a simple design. Furthermore, it can be easily performed at different periods of the season wherever the player may be. It should be also used to judge of the efficiency of different training regimens or to analyse the effects of factors that could affect tennis performance (e.g. supplementation, drinking regimens).

CONCLUSIONS

To conclude, field and laboratory tests appear to be complementary and of different use in tracking fitness changes in tennis players. Coaches and conditioning experts should use the present specific fitness test for tennis players as an additional test for training. This test, which is specific to tennis play, provides information on a player's individual fitness level and can be easily administrated. Considering that the ability to maintain a high percentage of maximal HR (80-90%) during relatively long periods simulating competition was shown to be relevant in tennis, direct measurement of respiratory gas exchange variables during this proposed field test may be useful to determine reproducible ventilatory breakpoints in order to determine the training intensity zones.

REFERENCES

Brooks, G. A. (1986). The lactate shuttle during exercise and recovery. Med Sci Sports Exerc,18(3), 360-368.

Davey, P.R., Thorpe, R. D., & Williams, C. (2002). Fatigue decreases skilled tennis performance. J Sports Sci, 20 (4), 311-318.

Fernandez Fernandez, J. (2005). Specific field tests for tennis players. Medicine and Science in Tennis, 10 (2), 22-23.

König, D., Huonker, M., Schmid, A., Halle, M., Berg, A., & Keul, J. (2001). Cardiovascular, metabolic, and hormonal parameters in professional tennis players. Med Sci Sports Exerc, 33 (4), 654-658.

Lees, A. (2003). Science and the major racket sports: a review. J Sports Sci, 21 (9), 707-732.

Smekal, G., Baron, R., Pokan, R., Dirninger, K., & Bachl, N. (1995). Metabolic and cardiorespiratory reactions in tennis-players in laboratory testing and under sport-specific conditions. Wien Med Wochenschr,145 (22), 611-615.

Smekal, G., Pokan, R., von Duvillard, S.P., Baron, R., Tschan, H., & Bachl, N. (2000). Comparison of laboratory and "on-court" endurance testing in tennis. Int J Sports Med, 21 (4), 242-249.

Vergauwen, L., Madou, B., & Behets, D. (2004). Authentic evaluation of forehand groundstrokes in young low- to intermediate-level tennis players. Med Sci Sports Exerc, 36 (12), 2099-2106.

Recommended Books and DVD

BOOKS

Tenis en la Escuela (Tennis in the School)

Author: Gema Torres and Luis Carrasco. Year: 2005. Language: Spanish. Level: All. Pages: 121. ISBN: 84-9729-038-0.

This book was written to help physical education teachers introduce tennis to school children and it is therefore appropriate for coaches working with junior beginner level players. The book is divided into 2 sections; the first is about the general concepts of tennis play, the history of tennis and also discusses some tactical and technical components. The second part discusses how to adapt tennis for players of the aforementioned age group. There are details on the use of teaching aids, the appropriate method for lesson progression and different activities and games that can be played. This book will be of interest and help to school teachers and those coaches working with beginner players.

For more information contact: www.inde.com

La Compétition Évolutive: "À chacun son match!" (Evolutive Competition: A match for everyone)

Author: French Tennis Federation. Year: 2005. Language: French. Level: All. Pages: 30. ISBN: 2-916131-02-7.

This book is a pocket guide for running match play and tournaments for all levels of players. It details how the French Federation suggest courts and scoring systems should be modified to make tennis match play more fun for players of all ages and abilities. Juniors are divided into 4 categories and each category has modifications with respect to court size, scoring system and the type of ball that should be used. This 30 page book will definitely help coaches and club officials who organise match play and tournaments for recreational players.

For more information contact: www.fft.fr

Winning at Tennis: It's all in your head...

Author: Antoni Girod. Year: 2005. Language: English. Level: All. Pages: 133. ISBN: 2-913053-05-X.

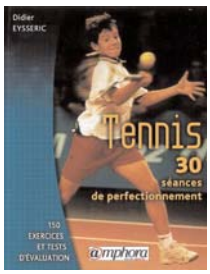
Antoni Girod is widely recognised as one of the worlds leading tennis psychologists. This book discusses "mental preparation" in two parts, 1) The basics and 2) Getting specific. The basics firstly discusses the "meaning of tennis" and then lists some values, beliefs, basic mental abilities, mental mechanisms and reflexes that Girod has found to be important in achieving peak tennis performance. The second part of the book gives more details on mental procedures for match day. It discusses; 1) Pre-match mindset, which includes tips on controlling motivation, visualisation etc., 2) Match mindset, this is about dealing with stress, using visualisation and having the right "look" and 3) Post-match mindset, which discusses how to evaluate performance after a match and prepare for future competition in a positive way.

Cyril Saulnier (Top 50 ATP) comments: "Antoni has helped me structure my mental game. I have lived his book - a work that will afford you the same advantage too".

For more information contact: www.agperf.com

Tennis 30 séances de perfectionnement (Tennis 30 lessons for competitive players)

Author: Didier Eysseric. Year: 2001. Language: French. Level: All. Pages: 165. ISBN: 2-85180-571-1.



More than 10 years of experiment in the teaching of tennis allowed Didier Eysseric to produce this book in an easy to follow lay out for all coaches. It details 30 different lessons plans that can be immediately implemented on the court. Each one of these lessons plans, with a well defined objective, describes 5 organised exercises that can be used in a progressive way for effective teaching. A book structure that is very well presented and with the assistance of diagrams the drills are very easy to follow and understand. The book also includes more than 30 different on-court tests that can be used to evaluate the progressions of players. This book is a good tool for any person wishing to teach tennis or learn new drills.

For more information contact: www.ed-amphora.fr

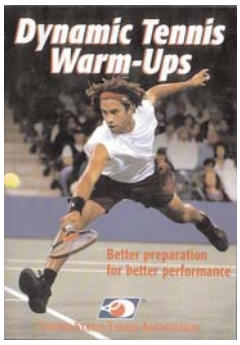
DVD

Dynamic Tennis Warm-Ups

Author: USTA. Year: 2004. Language: English. Level: All. Length: 45 min. ISBN: 0-73605-626-2.

This DVD will help you prepare your players for their next training session or match. It demonstrates how to get muscles ready quickly and correctly for tennis training and competition using a dynamic warm-up. Drawing from the latest research, training expert Mark Verstegen demonstrates how to prepare the body for forward and backward movements, side-to-side movements, and variable all-court movements in three dynamic warm-up routines. By regularly incorporating a dynamic warm-up into your tennis training, you will improve your movement efficiency and overall play. The three routines in this DVD serve as a great starting point for developing a challenging conditioning program.

For more information: http://www.humankinetics.com



ITF Coaching

ITF Ltd, Bank Lane, Roehampton, London Sw15 5XZ
Tel: 44 20 8878 6464 Fax: 44 20 8878 7799
E-mail: coaching@itftennis.com Website: www.itftennis.com/coaching
ISSN 1812-2302
Selected photo credits: Paul Zimmer, Ron Angle, Sergio Carmona, Marcelo Ruschel.