SPORT SCIENCE COMMITTEE

RESEARCH GRANT PROGRAM

“20 years of tennis specific research in the sport sciences”
As part of the mission of the USTA Sport Science Committee "To produce, evaluate, and disseminate sport science and sports medicine information relevant to tennis ", the USTA Sport Science Committee reviewed research proposals and provided research grants for the most deserving projects over a nearly 20 year period. This report summarizes the most significant findings of the research studies that received funding from the USTA during this time period. As part of receiving a USTA research grant, researchers were not only required to complete their scientific research but also to provide relevant applications for coaches, players and parents to further the knowledge in tennis science and tennis medicine.

As committee chairs during this time period, we would like to thank the many committee members who served and assisted with this process and helped to facilitate both the direction and quality of these research projects. It is through the continued pursuit of tennis-specific research that we can continue to gain insight into optimal methods and techniques for enhancing performance and preventing injuries.

We hope that the research summaries provided herein can help to further our understanding of the many factors needed to produce elite level tennis players. We acknowledge the support and role the United States Tennis Association has played in making this research possible. We are hopeful that directed research from the USTA sport science committee can continue as there remain so many unanswered questions in the areas of injury prevention, strength and conditioning, psychology, recovery and even in highlighting the health benefits of the game of tennis. We again thank the researchers, and committee members for making this body of work available for dissemination.

Jack L. Groppel, PhD

Todd S. Ellenbecker, DPT
(2003-2010)
USTA SPORT SCIENCE COMMITTEE MEMBERS 1988-2010

CHAIR OF COMMITTEE

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“TO PRODUCE, EVALUATE AND DISSEMINATE SPORT SCIENCE AND SPORT MEDICINE INFORMATION RELEVANT TO TENNIS”

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   Kibler¹, W.B., Chandler², J.T., Shapiro³, R., Conuel³, M. *Lexington Clinic Sports Medicine Center, Lexington, Kentucky¹, Jacksonville State University, Jacksonville, Alabama², University of Kentucky, Lexington, Kentucky³*
INTRODUCTION

- Mental rehearsal (or visualization) is technique used by athletes to help develop and better perform the skills and routines used in their sport.

- By imagining the performance of a skill, as well as the sights, smells, sounds, and physical feelings associated with the movement, a performer is able to practice a new skill, refine an existing skill, and/or get his or her mind and body ready for an upcoming performance.

- The systematic practice and use of mental preparation, in addition to the necessary physical training, has been found to be related to positive outcomes such as lowered performance anxiety, increased self-confidence, and accelerated skill learning.

- In support of this technique, there have been numerous reports by many different athletes about the beneficial effects of mental rehearsal on the learning and performance of their skills. However, systematic research has shown that visualization can at times produce erratic and sometimes detrimental effects if it is not carried out routinely or with the appropriate frame of mind.

- For some athletes, visualization training without an external aid (e.g., help from a coach or visual prop) can lead to errors such as visualizing performance mistakes or succumbing to negative thoughts and emotional responses during the mental rehearsal. An athlete who practices these errors will then be more likely to make the same mistakes while later physically performing the skills.

SAMPLE

- Participants for this study were 13 (8 male and 5 female) players enrolled in a beginning tennis program.

METHOD

- The players, whose age ranged from 8 to 12 years, were randomly selected to either participate in the video-assisted visualization training or a control group who did not receive the training.

- All players participated in the group lessons which were held for one hour, twice a week for four weeks.

- The video-assisted visualization training consisted of viewing a tape that showed a forehand and backhand model stroke performed by an accomplished male or female junior tennis player, the strokes performed by the individual participant, as well as the player’s stroke superimposed over a model stroke.

- The players who received the training were instructed to use the tape at least once a day as a prop to help develop a clear mental picture of what they needed to do to execute a correct backhand and forehand stroke.

- To measure the performance effects of the visualization training, five forehand and five backhand strokes of each participant were filmed and analyzed before and after the training period.

RESULTS

- Results indicated that the visualization training group did not have significantly better performance improvements than the players who did not participate in the program.

- However, the players who practiced the mental rehearsal techniques were rated as making bigger improvements than the other players 80% of the time.

RECOMMENDATIONS

- While the video-assisted visualization training did not significantly influence performance improvements in the forehand and backhand drives, the group of players who received the training did make bigger advancements in their techniques that those who did not participate in the training. These results are very promising considering the very short training period, the limited number of participants, and the “inadequate instruction” that was provided to the participants who used the visualization technique.

- In light of the tendency for children to enjoy non-verbal learning and with the evidence of this study, it seems that it may be useful to use video props for the learning of tennis strokes in addition to their use as a tool for stroke analysis.

- The video was useful for providing the players with a clear picture of their current performance as well as model performances of the forehand and backhand strokes.

- For visualization to be most effective, a player must also imagine other sensory information such as the smells and sounds of the court and competitive environment as well as the bodily sensations he/she feels when performing the skills.

- It is also useful to visualize a skill in slow motion to help develop a better sense of the intricate components of a series of movements. However, the player should eventually progress to a real-time mental rehearsal of the skill. An accelerated (or sped-up) visualization of a skill or movement is not suggested.

- It is crucial that players also mentally practice their skills with confidence and with positive cues so that these useful outcomes are also integrated into the players’ physical practices and performances.

- Mental skills, just like physical skills, need practice to become most effective. The more a player uses these skills, both on and off the court, the more he or she will benefit from the tool.

CONCLUSION

- Through the use of video-assisted visualization training a player can become better faster as well as receive positive feedback on their progress in a concrete, engaging manner.

- These positive outcomes could lead to increased participation and longer participation in tennis by making the game easier and more enjoyable to learn.
INTRODUCTION

The USTA is considering the use of two evaluative instruments in player development: The Psychological Performance Inventory for Sports (PPS) and the Competitive Adjective Profile. In order to make responsible and accurate decisions based on the results of these tools, the USTA must research the reliability and validity of the PPS and CAP.

Both instruments were developed by James E. Loehr to measure psychological attributes for competitive tennis players. Analysis of data from 160 junior players for the PPS and 140 players for the CAP were provided by the USTA. Only complete sets of responses were analyzed and information regarding sex, age, or skill was not provided or included in the study.

PURPOSE

• To present the estimated reliability and validity of the PPS and CAP;

• To present an initial estimate of the validity of the seven subscales of the PPS using factor analysis.

WHAT DID THE STUDY FIND?

• It appears that the USTA has two valid instruments to measure the competitive attributes of tennis players, however statistical analyses other than factor analysis should be considered.

• The CAP appears to be a very reliable instrument according to Cronbach’s Alpha Index reliability estimate and no major modifications or deletions are recommended.

• Although no major changes are recommended, the instrument should be redesigned to avoid personal bias. The present format tends to influence players to respond at the top of the scale where the positive qualities are listed. Switching some of the positive attributes to appear at the bottom of the scale and reversing the score may help players to be more objective in self-evaluation.

• The reliability estimate for the total score on PPS is very good, suggesting that the scale is reliable. Reliability estimates for 6 of the 7 subscales were acceptable with motivation being the only subscale with unacceptable reliability.

COACHING IMPLICATIONS

• If the CAP and PPS are to be used in a test and retest methodology, such as before and after a competition, test-retest reliability should be calculated.

• If these instruments are to be used in screening procedures or diagnostic manner, norm tables containing large data sets sorted by variables of sex and age should be created to compare player responses.

• When conducting additional analysis the age, sex and ranking of the player should be included in the study to examine resulting patterns of responses and potentially reduce current error variance in reliability and factor analysis.

REFERENCES / RESOURCES

Tennis Ability and its Influence on Perception

Issacs, L.
Wright State University

This research was funded by the USTA Sport Science and Medicine Research Grant (1989)

INTRODUCTION

• According to leading tennis authorities, the main goal in tennis is a simple one: to not be the first player to hit a short ball. Said differently, keep the ball deep in the opponent’s court. There are several advantages to this strategy: (a) your opponent will be pinned to the baseline, unable to take control of the net; (b) you reduce the angle in which your opponent can return your shot; and (c) you will have more time to react to your opponent’s return shot.

• Unfortunately, most beginning and intermediate tennis players have difficulty accomplishing this goal. While stroke technique is undoubtedly one important element that can influence groundstroke depth, it is possible that other less obvious factors may play a role in helping explain why lower level players are unable to consistently keep the ball deep.

• One such factor may be an inadequate awareness of where the shot has landed in the opponent’s court in reference to the court’s baseline (i.e., perceptual awareness). Beginning and intermediate players when instructed to hit deeper fail to respond, and this may occur because of a perception that the shot is already dangerously close to the baseline.

• This circumstance raises the question, does perceptual development and improvement account for a significant amount of the positive changes associated with improved level of tennis play?

PURPOSE

• The purpose of this study was to determine if changes in level of playing ability is accompanied by improvements in the ability to judge the depth of groundstrokes.

SAMPLE

• Participants for this study were 30 college students (25 males and 5 females) ranging in age from 18 to 29 years who were enrolled in a tennis class at a Midwest university. These individuals were grouped by their tennis playing ability as judged by the National Tennis Rating Program criteria (i.e., beginning, intermediate, and advanced intermediate)

METHOD

• Players were required to stand three feet behind the baseline and watch a tennis professional (standing next to the participant) project 10 tennis balls at random to each of four predetermined court zones.

• After watching the projected ball, the participants were asked to identifying which zone the tennis ball had landed and how far (i.e., short depth [between the net and 24 feet], ideal depth [within 6 feet of the baseline], average depth [the middle 9 feet of the court], or out) the ball had landed from the opposite baseline.

YEAR PERFORMED 1989

RESULTS

• There were no differences found between the beginning, intermediate, and advanced intermediate players’ ability to judge the depth of groundstrokes.

COACHING IMPLICATIONS

• The results of this study found no differences in the ability to judge the depth of a groundstroke between beginning, intermediate and advanced intermediate players, which suggests that perceptual development (due to factors such as increased maturity, experience, etc.) do not sufficiently account for performance improvements in tennis players.

• The researchers then explained that these results should be considered with caution for several reasons:

  • No differences were found between the different participant groups because all players were extremely successful in correctly judging the appropriate zone and depth of where the balls were hit.

  • This high success rate may have been due to the fact that the zones chosen for the study were relatively large, which may have resulted in a perception task that was too easy to discriminate between different ability levels.

  • The high success rate may have also been due to the fact that the balls were struck by the professional and not the participants themselves, which would have, again, caused the task of judging the depth of the ball’s trajectory to be fairly easy.

  • A third possibility for the high success rate could be that the task was made easier because the participants were allowed to focus all of their attention on the ball’s path. If placed in a real game situation, a player’s attention would be divided because he or she would also have to attend to factors such as opponent’s position and body movements (a much more challenging task).

  • Therefore, it may be true that if the task used in the study was more challenging and/or more realistic in terms of a true tennis experience, the results may have shown differences in perceptual ability between the three groups of players.

REFERENCES / RESOURCES


A Case Study of the Effectiveness of a Mental Training Program

Brown, S.W.
University of Connecticut

This research was funded by the USTA Sport Science and Medicine Research Grant (1990)

INTRODUCTION

Numerous studies indicate that mental training can be an effective approach to improving the performance of athletes involved in a variety of sports. It has also been discovered that there is no magical formula or universal mental training program that works for every athlete. Many factors such as an individual’s strengths and weaknesses, goals, sport, and personality determine what type of approach should be used. This study sought to determine the usefulness of a mental skills training program designed for a female collegiate tennis player who suffered from performance disruptions such as letting down on weaker opponents, losing concentration after getting a lead, and negative results from not taking sufficient time to warm up and prepare mentally before a match. It was decided that a mental skills program comprised of Cognitive Behavior Therapy (CBT) and a Preshot Routine (PR) would be beneficial for this particular player. CBT is an intervention strategy that is designed to identify and combat unproductive and disruptive thoughts that negatively affect an individual’s feelings and behaviors (e.g., on-court performance). PRs are systematic and ritualistic routines for a very specific situation (e.g., the moments before a serve) that can help a player increase concentration, better control the pace of play, plan for the next point, and increase consistency across various match situations.

PURPOSE

• The purpose of this study was to examine the effects on competitive tennis performance of an individually-tailored, mental training program containing Cognitive Behavior Therapy (CBT) and Preshot Routine (PR) components. Performance was measured by the average number of unforced errors per game, service return errors, and percentage of first serves in.

• The one participant for this case study was a 20 year old, female playing her third year of collegiate tennis at a large, urban, southeastern university. This athlete was described by her coach as having superior athletic ability relative to her teammates but lacking the mental skills necessary to realize her full potential in tennis. To help determine what components to include in the mental skills training program several assessments were completed by the player that measured characteristics such as anxiety, mood, motivation, reasons for being physically active, and thoughts, feelings, and mental skills already used during competition. The first portion of the program, CBT, took place over five sessions and focused on the players’ negative thoughts that occurred before and during a match that appeared to disrupt her concentration and ability to perform. The PR intervention began four weeks after the CBT training and was conducted over three and a half sessions on and off the court. The developed PR was comprised of four stages (Plan, Ready, Focus, and Fire) and was completed before each service and return of serve during practices and matches. During the Plan phase, the player mentally “dismissed” the previous point and planned a strategy for the next point. For the Ready phase, she used deep breathing and shoulder slouching to physically relax while she was getting into position. The Focus stage involved selecting a specific visual target (e.g., racquet throat when serving) so that distractions were minimized. Finally, the Fire stage was the actual skill execution. The performance indicators (i.e., average number of unforced errors per game, service return errors, and percentage of first serves in) were assessed before the mental skills intervention began and throughout the following competitive season (13 of the 22 matches played).

RESULTS

• Overall, the player’s feedback for both the Cognitive Behavior Therapy (CBT) and Preshot Routine (PR) was positive.

• However, her feelings about receiving results of her initial psychological testing were mixed. She indicated that while the test results were interesting, she did not think they had a significant impact on her performance.

• On the other hand, she believed the CBT helped her understand she could control her thoughts during a match to positively affect her performance.

• The player also indicated the PR was effective in helping her control her emotions on court because it made her feel more in control of herself, especially the on-court sessions.

• She also felt the PR sessions increased her overall motivation to play tennis. This is a rather important finding because the player had expressed earlier in the season the desire to quit the team.

• The mental training program had mixed results on the player’s tennis performance.

• Both CBT and PR had a positive effect on the average number of unforced errors per game and on service return errors.

• However, because performance measures before the training varied it is difficult to determine if the decreases in errors after the training was due to the intervention or just the natural variation in the performance.

• This variation also made it impossible to determine if the training program had an effect on percentage of first serve in. However, there is some evidence that service percentage did show some improvement.

• In general, the performance indicators that were measured before and after participation in the mental training program and the player’s reports about her experiences suggest that the program had a positive effect on the athlete’s on-court performance and overall enjoyment of her sport participation.

• Performance improvements (i.e., the average number of unforced errors per game, service return errors, and percentage of first serves in) were likely due to the player’s increased focus and confidence during her matches.

• The player’s increased motivation also played an important role in increasing her effectiveness during practices and competition.

• The components for the training program that was designed for this player were determined from the results of interviews with the athlete and her coach as well as results from several psychological assessments. While the athlete did not feel that becoming aware of these results had a direct impact on her performance, it seems that they were useful in informing the choice of mental training program goals and elements.

• To most effectively tailor programs such as these to your athlete, it is important to first understand his or her individual strengths, weaknesses, and goals.

• While CBT and PR proved to be useful strategies for this athlete, they may not work for all players in all situations, so this assessment period is critical for determining the most needed and useful strategies.

• According to the player, an especially useful component of the training program was the on-court PR sessions.

• This component may be effective for helping athletes focus and better control their emotions during practice and competitions.

• Another benefit of a mental training program is that it can increase communication between you and your players. Through this process, both you and your player will become more aware of his or her thoughts and feelings and are given the opportunity to discuss and work through the tennis related issues together.

REFERENCES / RESOURCES


YEAR PERFORMED 1990
INTRODUCTION

The United States Tennis Association (USTA) has developed a Parent-Player Tennis Training Program to build a player-parent-coach team in order to relieve the stress and pressure that can often reduce the enjoyment of the game for the youth athlete.

The program was also designed to promote overall player development. By using a system of team-building, parent profiling, written agreements, stress management training, problem solving, and mental toughness training the program hopes to bring parents to a new level of understanding and personal effectiveness with their child.

PURPOSE

The purpose of this study was to evaluate the Parent-Player Tennis Training Program’s usefulness and effectiveness from the feedback of players, parents, and coaches who had participated in the program.

Participants for this study were 15 player-parent-coach triads. Player participants were from a variety of regions across the country who were between 9 to 18 years of age. The mothers and fathers who also participated ranged in age from 32 to 58 years. To evaluate perceived changes based on the program, each member of the triad completed a separate assessment questionnaire before and after participating in the Parent-Player Tennis Training Program.

The players’ questionnaire focused on topics such as stress, emotional control, discipline, future tennis plans, self-esteem, attitude toward tennis, relationship with coach, feedback, and the coach-parent relationship. Parents answered similar questions, such as player discipline, player self-esteem, relationship with the player, as well as items such as the coach-player relationship and parental commitment to the player’s tennis.

Parents also completed a background information survey. The coach questionnaire contained items similar to those asked of the players and parents that addressed topics such as player characteristics, player-parent-coach relationships, and parental commitment to the player.

Finally, all three members of the triad completed a summary program assessment that measured their perceptions about the weekly meetings, the program questionnaires, the Parent-Player Tennis Training Program book, the supplementary book Net Results, and the total program package.

RESULTS

- Players’ reports indicated no significant differences in the key issues addressed by the program (e.g., discipline, self-esteem, player-parent-coach relationships) before and after participation in the Parent-Player Tennis Training Program.
  
  - However, there were numerous small positive changes in several areas such as stress, future tennis plans, relationship with mother, and emotional control.
  
  - Similar to the players’ responses, the parents and coaches did not report significant changes in the key program areas in the post-assessment as compared to the pre-program assessment, yet small positive changes were evident (e.g., attitude toward player’s tennis, player’s stress, parent-player relationship, parent-coach relationship, and player’s tennis plans).
  
  - In general, players, parents and coaches responded very favorably in their evaluation of the effectiveness of the Parent-Player Tennis Training Program.
  
  - The area that was judged to be most effective was the component that helped to develop communication between the coach and the parent.
  
  - There were no significant differences in how the members of the triad rated the program in the effectiveness evaluation.
  
  - All components of the program were rated useful.
  
  - While all groups rated the Parent-Player Tennis Training Program book to be useful, coaches rated it significantly higher than the players and parents.
  
  - Participants were also asked to openly comment on the program. The following are some of their responses:
    
    - “I thought this program helped me a lot with dealing with the many factors of tennis. Thank you.” (a player)
    
    - “…We were headed in the wrong direction with a talented, motivated player. The knowledge gained will help guide throughout his career. Without the program, would not have had a chance to work toward this goal effectively.” (a parent)
    
    - “This program should be continued twice a year with a new team each time” (a coach)
    
    - “…The books were great.” (a coach)
    
    - “…This program was excellent – we all benefited from the program!” (a coach)
    
    - Several changes for the program were recommended based on the analyses of the aforementioned results.
    
    - The amount of time required to complete the program should be reduced. This change may lead to more participants remaining in the program for its entire duration.
    
    - The amount of paperwork associated with the program should be reduced.
    
    - The program should be used with players early in their relationship with tennis and the specific coach.
    
    - The books should be used as an integral part of the program.

COACHING IMPLICATIONS

- Overall, the Parent-Player Tennis Training Program was judged to be useful and effective by players, parents, and coaches.

- Some of the small positive benefits that were found as a result of the program were player discipline, self-esteem, player-parent-coach relationships, and parent attitudes toward player’s tennis.

- It is suggested that by engaging in the program early in a player’s career with a new coach, this participation may be more useful in promoting healthy tennis development and relationships among the parent, player and coach.

- The program was rated equally useful by all three groups. Therefore, participation in the program not only benefits the player and his or her development and enjoyment of the game, but can also positively impact the involvement and enjoyment of coaches and parents who are involved in youth tennis.

REFERENCES / RESOURCES

Factors Influencing Tennis Coaches Ability to Predict Anxiety Level in Their Players

Gould, D. and Krane, V.
the University of North Carolina and Bowling Green State University

This research was funded by a USTA Sports Science and Medicine Research Grant (1990).

INTRODUCTION

• Outstanding tennis coaches possess the ability to read their players’ emotional states and use appropriate coaching strategies to deal with competitive anxiety.
• Coaches that are unable to accurately interpret player emotional states may choose the wrong tactics to “psych up” or calm down the athletes resulting in the incorrect arousal levels.
• More specifically, this study looks to measure the coaches ability to estimate their players’ trait (general tendency based on personality) and state (specific moment to moment) anxiety.
• Multidimensional anxiety measures which have not been used previously were used to aid the coaches’ observations of physical as opposed to cognitive, manifestations of anxiety.
• Important variables of coach empathy, communication skill, years of coaching experience, gender of the athletes, and relationship between coach and player were also examined.

PURPOSE

The purpose of this study was twofold:
• To determine the ability of tennis coaches to accurately assess their players state and trait anxiety levels.
• To identify factors which were related to coaches’ abilities to assess player state and trait anxiety levels.
• This study is significant because it will identify the factors that will improve coaches’ ability to recognize types of player anxiety and choose appropriate course of action. Once the results are compiled, educational programs can be designed to help coaches improve their skills of recognition.

SAMPLE

• Participants for this study were twenty-seven collegiate coaches and 147 (101 females and 46 males) of their players.

YEAR PERFORMED 1990

METHOD

• Multidimensional trait anxiety was assessed with the Sport Anxiety Scale (SAS) and state anxiety was measured with the Competitive State Anxiety Inventory (CSAI).
• Measures of empathy were measured using the empathetic understanding subscale of Relationship Inventory (RI) and other measures included the Interpersonal Communication Inventory (ICI), Marlowe-Crown Social Desirability Scale (M-C SDS), and a demographic questionnaire.

RESULTS

The study discovered the following results:
• Empathy appeared to be an important variable in coaches’ prediction of anxiety level.
• Although some individual coaches successfully estimated anxiety levels, overall, coaches were not accurate in their estimates of athlete trait and state anxiety levels.
• Not surprisingly, coaches had a better feel for an athletes’ typical reaction to competition but not to how they felt in the moments just prior to competition.
• Some coaches varied greatly in their ability to estimate athletes’ trait anxiety.
• Overall, coaches were more accurate in estimating trait anxiety compared to state anxiety. In particular, coaches were better able to predict trait anxiety levels of female athletes than male athletes and that female coaches were more accurate predictors of their players’ anxiety levels.
• Coaches as a whole were not very accurate in estimating athlete state anxiety but female coaches with female players were had the highest correlation.

RECOMMENDATIONS

• Coaches should strive to create an atmosphere of open communication between athlete and coach. Communication skills are essential in the coaches’ ability to estimate player anxiety.
• Although coach empathy plays an important role in estimating player anxiety, specific types of empathy must be demonstrated while de-emphasizing other empathy components. The proper approach focuses on the ability to relate and communicate with athletes thereby improving the skill of detecting anxiety.
• Coaches striving to improve their ability to estimate player anxiety may consider administering the Sport Competition Anxiety Test (SCAT) to athletes during the preseason.
• The use of a state anxiety measure just prior to competition throughout the season is useful in identifying overanxious athletes.
• It is important for coaches to acknowledge and understand individual differences and know their athletes well enough to know when they display signs of distress.

Conclusions:
Coaches should actively look for signs of athlete anxiety in three areas behavioral, somatic or physiological arousal, and cognitive:
• Behavioral: changes in behavior, communication level, and facial expression
• Somatic: muscle tightness in neck, sore muscles, upset stomach, nervousness, urge to urinate, ringing of ears, throwing up, sweating, urge to urinate, flushed face, dilated pupils.
• Cognitive: inability to concentrate, negative concerns about performance, disrupted attention, fear of failure, feelings of inadequacy, loss of control and guilt.

CONCLUSION

• The coach can improve the ability to predict anxiety levels in players by learning to recognize physical signs that are specific to each player. Through the use of various tools and flexible communication skills, the coach can recognize and help the athletes deal with anxiety as a result of competition.
Visual Performance in Senior Tennis

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This research was funded by the USTA Sport Science and Medicine Research Grant (1990)

INTRODUCTION

• For over a century, the Snellen Eye Chart has been used to measure vision in stationary and fixed situations. This assessment tool commonly used in various doctors’ offices measures an individual’s ability to make out fine details and, therefore, recognize letters of decreasing size that are presented on a chart viewed from a distance.

• This method alone does not seem to be an effective predictor of visual performance for sport. More recently, contrast sensitivity function (CSF) has emerged as an important predictor in the assessment of visual performance. CSF is the degree to which an image can become faded before it is no longer distinguishable to the viewer. For example, if a person views a set of stripes, he or she is naturally more likely to be able to distinguish lines that are moderately wide and spaced apart. If a set of black lines are laid too thin and close to each other, we perceive a grey area instead of being able to make out the individual lines.

• Nearly one hundred investigations have been published involving CSF, yet few studies have been conducted involving CSF and its role in vision for sport and none have considered the relationships between CSF and pupil size.

• There were no significant performance differences between male and female senior tennis players in contrast sensitivity function (CSF) or speed of recognition.

• Male players had significantly larger size pupils than the female participants.

• Overall, the CSF levels of the male and female players fell within the normal range for individuals of their age.

PURPOSE

The purpose of this study was to determine whether there were performance differences in contrast sensitivity function (CSF), pupil size, and speed of recognition between male and female senior tennis players.

SAMPLE

Participants for this study were 30 (15 males and 15 females) tennis players aged 40 to 45 years. All players were members of USTA Senior teams and were selected through a screening process because of certain vision criteria such as 20/20 vision in both eyes, same eye near and far dominance, and acceptable three-dimensional vision, and color perception.

METHODS

To measure the participants’ CSF, the players viewed a screen of various striped squares with decreasing thickness and increasing spacing that were either tilted to the left, to the right, or straight up. The players were instructed to identify the last square in which lines were visible and the direction in which they were tilted. The pupil size and speed of recognition of each player were also tested.

WHAT DID THE STUDY FIND?

• There were no significant performance differences between male and female senior tennis players in contrast sensitivity function (CSF) or speed of recognition.

• Male players had significantly larger size pupils than the female participants.

• Overall, the CSF levels of the male and female players fell within the normal range for individuals of their age.

COACHING IMPLICATIONS

• The findings of the study suggest that males and female senior tennis players do not differ in several critical areas of their visual performance (i.e., contrast sensitivity function and speed of recognition).

• Therefore, it does not seem likely that performance differences between males and females from similar populations are attributable to these vision criteria.

• One difference that was found between the two groups was that the male players tended to have larger pupil sizes.

• This tendency for larger pupils may predispose senior male players to have less visual sharpness than their female counterparts and may be more likely to experience performance problems due to this visual factor than their female counterparts.

REFERENCES/ RESOURCES

INTRODUCTION

• For the successful development of movement skills, a child needs to acquire the ability to perform effectively in the performance environment. This ability becomes even more critical when the environment is dynamic and constantly changing (e.g., competing in ‘open’ environment sports such as soccer, hockey, and tennis).

• The individual, or athlete, must then be able to perform a movement in the right place at the right time. In order to do so, one must be able to pull information from past events and apply it to the present situation. In other words, he or she must be able to anticipate the changes and movements within the environment and adapt appropriately.

• If a child improves his/her ability to predict future events, performance in the open sporting environment should be enhanced. Unfortunately, how to best improve children’s anticipatory abilities and processes remains unclear.

PURPOSE

• The purpose of this study was to determine if a blocked or random training method is more effective for teaching a timing task to young children. The influence of gender in this learning process was also examined.

SAMPLE

Participants for this study were 40 children (20 males and 20 females) who were between 6 and 7 years of age.

METHOD

• The task the children completed was to watch a series of flashing lights and to push a button at the same time as the illumination of the last light. Children were trained one day on either blocked speeds (e.g., 2mph, 2mph, 2mph, 3mph, 3mph, 3mph, 3mph, etc.) or randomly occurring speeds (e.g., 2mph, 4mph, 1mph, 2mph, 6mph, etc.) of the flashing lights.

• The trial speeds used during the training sessions were 2 mph, 3 mph, 4 mph, and 6 mph with 4 trials occurring at each speed. After 24 to 48 hours, the children were tested on a similar task at speeds of 6mph, 8mph, 9mph, and 10mph.

• The speeds during this testing period were presented in a random fashion to all participants. The results of the tests were measured in the number of errors the children made in the task (e.g., pushing the button too early or too late).

YEAR PERFORMED 1990

RESULTS

• During the testing trials, completing the task at 6mph was the least difficult for both males and females.

• However, while females made more errors as the speed of light presentation increased, males did not.

• Females made the most errors at 10mph in the blocking trials, whereas males did the most poorly at 10mph in the randomly occurring speed trials.

• Overall, males performed better on the timing task than the females at 8, 9, and 10mph.

• Also, males made significantly less errors than the female participants in both the random and blocked trials.

COACHING IMPLICATIONS

• Unfortunately, the results of this study do not support a statement of the superiority of one training mode for the learning of a timing task in young children.

• Therefore, when teaching skills to be used in a dynamic environment, such as the tennis court, it would be most useful to determine and use the training mode that works best for the individual athlete. Some athletes may perform and learn best when first taught skills in slow motion then sequentially increasing the speed at which the skill is performed.

• On the other hand, some athletes may learn best in a style that changes speed of skill practice in a random fashion (which may more closely mimic the actual speed changes in a competition).

• The results do suggest there is a difference in training effects for males and females.

• During the training phase, females made more errors and typically reacted more slowly than the males.

• The girls also tended to make more errors in the testing phase as well.

• The greatest amount of errors for these girls were made at the fastest speed at which they were trained (10mph) and when the speeds of light presentation were done so in a blocked fashion.

• This finding suggests that training at random speeds when learning a fast-paced skill may be best for young girls.

• Another interesting finding was that boys and girls had similar performances for the tasks at 6mph in the testing phase unlike the other trials in which boys consistently outperformed the girls.

• It may be true that the similar performances occurred because the participants completed the task at this speed for both the training and testing phases. This extra practice may have not made a difference in the boys’ performance that may have already reached its peak, but gave the girls the practice needed to approach the same level of performance as the boys.

• Generally, girls do not appear to be getting sufficient experience and exposure to tasks demanding the anticipation and timing skills that were tested in this study. Until this deficit is corrected, their performance of skills in a dynamic environment will lag behind boys.

REFERENCES / RESOURCES


Assessing Players’ Thoughts and Emotions during Competition

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This research was funded by a USTA Sports Science and Medicine Research Grant (1992).

INTRODUCTION

Performance enhancement programs have been of great interest to athletes, coaches, and researchers for all levels of sport, with the methods and strategies used to increase the performance and enjoyment of players receiving great attention.

Unfortunately, we have yet to find a reliable way to measure players’ thoughts and emotions during competition, which is an important aspect of any successful intervention program.

Interpersonal Process Recall is a method, more commonly used to train communication skills in new counselors, by which the recall of thoughts and emotions in a particular situation is aided by viewing video recordings of the situation in question. Recall is further reinforced by an interviewer who actively listens and asks non-judgmental questions about the events viewed on the tapes.

The purpose of this project was to investigate if IPR could be used to help athletes better remember their thoughts and feelings experienced during match play so that performance enhancement interventions could be better informed.

PURPOSE

The purpose of this study was to determine the usefulness of Interpersonal Process Recall (IPR) as a tool to gauge players’ thoughts and emotions during competitive tennis match play.

SAMPLE

Participants for this study were six adult female players participating in the Houston Tennis Association Women’s Singles League. All players were members of the same club and had performance rankings of 3.0 or 4.0.

YEAR PERFORMED 1990

METHOD

To investigate the effectiveness of IPR at various levels of tennis play, three freshmen members of the University of Houston Women’s Tennis Team also participated in the study.

These players had performance ratings of 5.0 or higher. Each athlete completed 3 taping and observation sessions in which they viewed a video of a match they had just completed and were encouraged to give in-depth explanations of their thoughts and feelings during the competition.

To increase players’ recall, an interviewer asked questions such as “what were you thinking at that time,” “what would you have liked to have done,” or “what were you physically feeling” while the tapes were being viewed.

RESULTS

When recalling feelings and thoughts experienced before their matches:

- Recreational players with rankings of 3.0 reported feeling calm, relaxed, and confident
- College players with rankings of 5.0 reported experiencing anxiety, fear and frustration (which may have been due to the fact that they competed against opponents with higher NCAA rankings during both observed matches)
- Players with ratings of 4.0 showed varied negative and positive responses to competition.

When recalling feelings and thoughts experienced during competition:

- Winning 3.0 players continued to show positive emotional patterns;
- Winning 5.0 players continued to report negative emotions similar to their warm-up report
- Winning and losing 4.0 players’ responses were more similar to the 5.0 players than to the 3.0 players.

When recalling feelings and thoughts experienced after competition:

- The 5.0 players continued to show stronger negative emotions, even when winning, than the other two levels of players.

RECOMMENDATIONS

- The Interpersonal Process Recall (IPR) method was judged to be a valuable experience by the players who completed the three recall sessions.
- While the players reported knowing their thoughts and emotions while on the court, they also believed IPR helped made them even more aware.
- This heightened awareness is often an important first step in performance enhancement interventions.
- Several players, however, did mention a common problem with the IPR process.
- Athletes reported the 30 to 45 minutes needed for the recall sessions was too long. This is not surprising considering several of these players had worked all day and started their tennis matches at 6:30pm.
- Other responsibilities at home or with school were viewed as more important and in need of more immediate attention than taking part in the project.
- For athletes to buy into an intervention, they must first believe it is worth their while. Therefore, it is important that the process be as convenient and engaging as possible.
- Issues such as maladaptive thinking patterns or a lack of emotional control during tennis competition is often invisible to observers and difficult for players to remember after the fact.

CONCLUSION

- In summary, IPR would be a valuable clinical tool to help players become more aware of the thoughts and feelings experienced during competitive play.
- By showing players video of competitions and providing assistance through a supportive and non-judgmental listener, sport psychology consultants and coaches can gather information about these illusive experiences that can be useful in developing appropriate performance enhancement interventions.
A Case Study of the Effectiveness of a Mental Training Program

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The project was aided by a grant from the United States Tennis Association (1990)

INTRODUCTION

• Numerous studies indicate that mental training can be an effective approach to improving the performance of athletes involved in a variety of sports.
• It has also been discovered that there is no magical formula or universal mental training program that works for every athlete. Many factors such as an individual’s strengths and weaknesses, goals, sport, and personality determine what type of approach should be used.
• This study sought to determine the usefulness of a mental skills training program designed for a female collegiate tennis player who suffered from performance disruptions such as letting down on weaker opponents, losing concentration after getting a lead, and negative results from not taking sufficient time to warm up and prepare mentally before a match.
• It was decided that a mental skills program comprised of Cognitive Behavior Therapy (CBT) and a Preshot Routine (PR) would be beneficial for this particular player.
• CBT is an intervention strategy that is designed to identify and combat unproductive and disruptive thoughts that negatively affect an individual’s feelings and behaviors (e.g., on-court performance).
• PRs are systematic and ritualistic routines for a very specific situation (e.g., the moments before a serve) that can help a player increase concentration, better control the pace of play, plan for the next point, and increase consistency across various match situations.

PURPOSE

• The purpose of this study was to examine the effects on competitive tennis performance of an individually-tailored, mental training program containing Cognitive Behavior Therapy (CBT) and Preshot Routine (PR) components.

SAMPLE

• The one participant for this case study was a 20 year old, female playing her third year of collegiate tennis at a large, urban, southeastern university.
• This athlete was described by her coach as having superior athletic ability relative to her teammates but lacking the mental skills necessary to realize her full potential in tennis.

METHOD

• To help determine what components to include in the mental skills training program several assessments were completed by the player that measured characteristics such as anxiety, mood, motivation, reasons for being physically active, and thoughts, feelings, and mental skills already used during competition.
• The first portion of the program, CBT, took place over five sessions and focused on the players’ negative thoughts that occurred before and during a match that appeared to disrupt her concentration and ability to perform.
• The PR intervention began four weeks after the CBT training and was conducted over three and a half sessions on and off the court. The developed PR was comprised of four stages (Plan, Ready, Focus, and Fire) and was completed before each service and return of serve during practices and matches.
• During the Plan stage, the player mentally “dismissed” the previous point and planned a strategy for the next point.
• For the Ready phase, she used deep breathing and shoulder slouching to physically relax while she was getting into position.
• The Focus stage involved selecting a specific visual target (e.g., racquet throat when serving) so that distractions were minimized.
• Finally, the Fire stage was the actual skill execution.
• The performance indicators (i.e., average number of unforced errors per game, service return errors, and percentage of first serves in) were assessed before the mental skills intervention began and throughout the following competitive season (13 of the 22 matches played).

RESULTS

Overall, the player’s feedback for both the Cognitive Behavior Therapy (CBT) and Preshot Routine (PR) was positive.

However, her feelings about receiving results of her initial psychological testing were mixed. She indicated that while the test results were interesting, she did not think they had a significant impact on her performance.

On the other hand, she believed the CBT helped her understand she could control her thoughts during a match to positively affect her performance.

The player also indicated the PR was effective in helping her control her emotions on court because it made her feel more in control of herself, especially the on-court sessions.

She also felt the PR sessions increased her overall motivation to play tennis. This is a rather important finding because the player had expressed earlier in the season the desire to quit the team.

The mental training program had mixed results on the player’s tennis performance:
• Both CBT and PR had a positive effect on the average number of unforced errors per game and on service return errors.
• However, because performance measures before the training varied it is difficult to determine if the decreases in errors after the training was due to the intervention or just the natural variation in the performance.
• This variation also made it impossible to determine if the training program had an effect on percentage of first serve in. However, there is some evidence that service percentage did show some improvement.

RECOMMENDATIONS

• In general, the performance indicators that were measured before and after participation in the mental training program and the player’s reports about her experiences suggest that the program had a positive effect on the athlete’s on-court performance and overall enjoyment of her sport participation.
• Performance improvements (i.e., the average number of unforced errors per game, service return errors, and percentage of first serves in) were likely due to the player’s increased focus and confidence during her matches.
• The player’s increased motivation also played an important role in increasing her effectiveness during practices and competition.
• The components for the training program that was designed for this player were determined from the results of interviews with the athlete and her coach as well as results from several psychological assessments. While the athlete did not feel that becoming aware of these results had a direct impact on her performance, it seems that they were useful in informing the choice of mental training program goals and elements.
• To most effectively tailor programs such as these to your athletes, it is important to first understand his or her individual strengths, weaknesses, and goals.
• While CBT and PR proved to be useful strategies for this athlete, they may not work for all players in all situations, so this assessment period is critical for determining the most needed and useful strategies.
• According to the player, an especially useful component of the training program was the on-court PR sessions.
• This component may be effective for helping athletes focus and better control their emotions during practice and competitions.
• Another benefit of a mental training program is that it can increase communication between you and your players. Through this process, both you and your player will become more aware of his or her thoughts and feelings and are given the opportunity to discuss and work through the tennis related issues together.

YEAR PERFORMED 1990
Burnout in Competitive Junior Tennis Players

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This research was funded by a USTA Sports Science and Medicine Research Grant (1993/1994).

INTRODUCTION

• There is considerable concern both inside and outside the tennis community regarding competitive pressures placed on junior players. These pressures have been found to lead to detrimental consequences such as burnout.

• Smith (1986) defined burnout as a psychological, emotional, and physical withdrawal from a formerly pursued and enjoyable sport as a result of excessive stress that acts on an athlete over time.

• Burnout can be influenced by a number of factors, which include perfectionism, a lack of assertiveness skills, the need to please others, excessive training workloads, parental pressure, the repetitive nature of sport, inconsistent coaching practices, overuse injuries, and excessive time demands (Feigley, 1984; Juha, 1986; Smith, 1986).

• In response to continuing concern with junior tennis burnout and lack of scientific research on the topic, this investigation was commissioned by the USTA to obtain an accurate description of junior tennis burnout that would not be specific to a particular region of the country and would adequately represent junior tennis as it is played in the United States.

PURPOSE

To identify and psychologically describe junior tennis burnouts and compare these individuals to players who did not burnout of junior tennis.

PHASE 1: RESULTSPHASE 1: RESULTS

Relative to the comparison players, burnout players:

Demographics
• had less input into their training;
• were more likely to have played on their high school team;
• were more likely to have played in higher age divisions in tournaments, and;
• practiced fewer days.

Psychological Variables
• were lower in external motivation;
• were higher in attribution (lack of motivation);
• reported being more withdrawn.

Personality Variables
• were higher on perceived parental criticism and expectations;
• had higher need for organization;
• experienced greater concern over mistakes; and
• had lower personal standards.

Coping Skills
• were less likely to use planning strategies; and
• were less likely to reinterpret adversity and issue as positive and growth coping skills.

RECOMMENDATIONS

• View Burnout as Being Caused by an Interaction of Player Characteristics and Situational Demands.

• Avoid treating burnout as a personality weakness. Doing so could lead to players feeling reluctant to ask for help because of embarrassment.

• Monitor Burnout Levels in Players

• Know the signs and symptoms of burnout (see phase 1 & phase 2 results).

• Establish open lines of communication with your players so that you are made aware of how your players are coping with sport-related demands.

• Parental Education

• Parents can aid in monitoring, preventing, or alleviating signs and symptoms of burnout by being more aware of the critical role they play in their child’s tennis and by being exposed to other topics such as of optimal push and appropriate parental involvement.

• Provide a Socially Supportive Junior Tennis Environment

• Provide more doubles play opportunities in junior tennis and place more emphasis on the USTA’s “team tennis” program in which players travel to tournaments as teams—not playing their own teammates.

• Player Education

• Provide the athletes with suggestions for preventing and diminishing the effects of tennis burnout (see phase 2 results – advice to players).

• Allow Players to Have Input Into Training

• Provide players the opportunity to give you feedback on your decisions about training and competition.

• However, do not abandon your moral and legal responsibilities of ensuring a healthy and safe tennis program and playing environment.

• Limit the Possibilities of Players “Playing-Up” in Age Divisions

• Moving up in age divisions is not for everyone. Resulting consequences could be both physical (e.g., injury) and psychological (e.g., feelings of isolation).

• Minimize Parental Criticism and Coaching

• Encourage parents to take a supportive role in their child’s tennis involvement that does not involve in-depth critiques of on-court activities such as strokes and play.

• It is suggested that parents not coach their own children in junior tennis, especially at the more intense levels of play.

• Recognize and Limit Travel Demands

• In addition to the normal stress of tennis training and competition, being away from home and friends was also found to create stress in the young athletes.

• Beware of Overtraining

• Carefully monitor both organized and informal training regimens of athletes because overtraining can lead to burnout in some athletes.

• Emphasize the Fun of Junior Tennis

• Common results of maintaining a fun atmosphere in the tennis environment are reduced stress, better play, and increased wins.

• Teach Preventative Stress Management Strategies to Players

• Junior tennis players need to master stress management and coping skills to prevent burnout, play to their potential, and fully enjoy the game.
An Examination of Mental Skills Training in Junior Tennis Coaches: Focus Groups

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This research was funded by the USTA Sport Science and Medicine Research Grant (1996)

INTRODUCTION

• The last decade has seen considerable attention being spent on mental skills training.
• USTA Player Development was concerned that despite the availability of information for mental skills in tennis, very few junior coaches were not systematically teaching mental skills to their players.
• Little is known about how to teach coaches to teach mental skills to their players.

PURPOSE

• To understand why mental skill training information was not being used by junior tennis coaches.
• Additionally, what opinions do coaches have about what would make mental skills training information more user-friendly and strategies for conveying this information to coaches.

METHODS

• Four focus groups were held with 20 junior tennis coaches at a three day USTA seminar.
• Five coaches were in each focus group.
• Focus groups lasted 75 minutes
• Coaches were randomly assigned to groups after controlling for gender. Three groups were all male and two groups included two females so that one group did not have only women, but women had same-gender support in their group.
• Focus groups were used because very little research was conducted on this topic.

PARTICIPANTS

• 16 men and 4 women participated in the focus group sessions.
• Coaches had on average 14.5 years of experience.
• Coaches represented all regions of the US.
• Coaches came from a variety of tennis environments including high school teams, country clubs, urban leagues, and college teams.
• On average, they had coached 17 sectionally and 5 nationally ranked players.
• 85% had USPTA or USPTR certification
• Coaches felt that they had a moderate degree of knowledge about sport psychology (M = 4.33 on a 7 point Likert scale, where 7 = extensive knowledge)
• Coaches believed that mental skills training was very important for junior player (M = 9.00 on a 10 point Likert scale, where 10 = very important)
• Coaches felt they had better than average ability to develop mental skills in their players (M = 5.03, where 10 = very good ability)
• Coaches spent an hour each on mental skills training.
• Coaches perceived mental skills as difficult to teach (M = 4.23 where 7 = very difficult).

WHAT DID THE STUDY FIND?

How do you teach mental skills to your players?
• Two categories emerged: general process strategies and specific exercises/strategies.
• General Process Strategies
  • Consulting with a sport psychologist
  • Using videos to increase awareness
  • Recognizing and adjusting to individual differences
  • Parent education and guidance
  • Teaching in a progression
  • Reading articles
  • Building trust/relationship (constructing plan for player, building relationship, being professional, giving freedom)
  • Role models (coach or player)
  • Fun and interesting presentations
• Specific Exercises/Strategies
  • Quality-focused practices
  • Shaping behaviors
  • Reflection and self-awareness
  • Subtle integration into practice
  • Analogies
  • Audio tapes

METHODS

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RESULTS, CONT.

Why Coaches Do and Do Not use Mental Skills Training

14 reasons emerged
1. Lack of training. Need for developing coaching education to teach coaches how to do mental skills training
2. Level of understanding mental skills training content
3. Knowing how to teach the mental skills/process
4. Need for learning alternative mediums of conveying information
5. Becoming more comfortable teaching mental skills
6. Coaches never use mental skills themselves
7. Need to individualize mental skills training
8. Getting players engaged in the training more
9. Difficult to implement and evaluate
10. Increasing motivation
11. Modeling other who provide mental skills training
12. Teaching parents about the value of mental skills training
13. Obtaining cooperation from tennis organizations
14. Other responsibilities

COACHING IMPLICATIONS

• Interestingly, coaches felt they had the content knowledge, but not the process knowledge of how to teach, individualize, and make concrete the mental skills.
• There is some lack of comfort in teaching mental skills.
• More on-court demonstrations of mental skills training are needed.
• There is a need to create more concrete, hands-on mental training examples that come in a variety of mediums.
• Many factors influence mental skills training success including the age, ability, gender, and culture of the player. This is the art of mental skills training knowing how to individualize to the person and the situation.
• A model of coaching mental skills in tennis was developed based on these focus groups and is included in the mental skills and drills booklets.

REFERENCES / RESOURCES

A Survey of Mental Skills Training Knowledge, Opinions, and Practices of Junior Tennis Coaches

Gould, D., Medbery, R., Damarjian, N., and Lauer, L.  
University of North Carolina Greensboro  
This research was funded by the USTA Sport Science and Medicine Research Grant (1996)

INTRODUCTION

- USTA Player Development has made significant efforts to better educate coaches about sport psychology for the purposes of enhancing player development and performance.
- Are coaches employing, with junior players, the sport psychology curriculum being taught during coaching education?
- An exploratory focus group study was conducted to better understand if coaches are using mental skills training information being passed onto them, and how. Furthermore, it was important to identify ways to more efficiently and effectively convey this information to them.
- Focus groups were conducted with 20 elite junior tennis coaches (5 coaches per group) participating in a USTA coaches education program (Gould, Damarjian, & Medbery).
- Coaches felt that mental skills training included emotional control, focus and readiness, passion, and the ability to develop a winning strategy.
- A need for mental skills training for coaches was identified, and that coaches need to become more comfortable with mental skills training information.
- Training should focus on content and process of how to teach mental skills.
- Mental skills training information needs to be more user-friendly.

PURPOSE

- Because the previous study interviewed 20 coaches, a large scale survey of junior coaches mental skills knowledge, opinions, and practices was needed.
- Specifically, how important is mental skills training?
- What mental skills do junior tennis coaches teach?
- How do coaches teach these mental skills?
- What are recommendations for making mental skills training more effective?

METHOD

- Participants at the 1997 USTA area training center workshop were surveyed.
- 153 of the 325 coaches in attendance completed the survey (47%)

PARTICIPANTS

- 82% of coaches were male
- 90% of the coaches were Caucasian, 5% African-American, 2% Hispanic, and 1% Asian-American.
- Coaches averaged 38 years of age with 1.5 to 45 years of experience.
- Coaches on average worked with 10.9 sectionally ranked players and 2.5 nationally ranked players.

YEAR PERFORMED 1997

WHAT DID THE STUDY FIND?

Importance of Mental Skills Needed in Junior Tennis

<table>
<thead>
<tr>
<th>Mental Skill</th>
<th>Mean Importance</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment/Fun</td>
<td>9.70</td>
<td>1.01</td>
</tr>
<tr>
<td>Focus/Concentration</td>
<td>9.53</td>
<td>0.82</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>9.45</td>
<td>1.25</td>
</tr>
<tr>
<td>Emotional control</td>
<td>9.51</td>
<td>1.16</td>
</tr>
<tr>
<td>Honesty/Integrity</td>
<td>9.11</td>
<td>1.65</td>
</tr>
<tr>
<td>Motivation/Passion</td>
<td>9.10</td>
<td>1.50</td>
</tr>
<tr>
<td>Practice Intensity</td>
<td>9.00</td>
<td>1.35</td>
</tr>
<tr>
<td>Positive Thinking/Self-Talk</td>
<td>9.05</td>
<td>1.29</td>
</tr>
<tr>
<td>Positively Managing Mistakes</td>
<td>8.96</td>
<td>1.44</td>
</tr>
</tbody>
</table>

Note: A rating of 1 signifies not important and 10 very important. A total of 24 mental skills were rated.

Three Most Important Mental Skills Needed by Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Enjoyment/Fun</th>
<th>Focus/Concentration</th>
<th>Self-confidence</th>
<th>Emotional Control</th>
<th>Goal Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 and Under</td>
<td>14 and Under</td>
<td>16 and Under</td>
<td>12 and Under</td>
<td>14 and Under</td>
<td>16 and Under</td>
</tr>
<tr>
<td>Enjoyment/Fun</td>
<td>27.3%</td>
<td>24.3%</td>
<td>21.1%</td>
<td>Focus/Concentration</td>
<td>50.0%</td>
</tr>
<tr>
<td>Focus/Concentration</td>
<td>10.0%</td>
<td>7.9%</td>
<td>6.8%</td>
<td>Goal Setting</td>
<td>7.7%</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>7.2%</td>
<td>6.2%</td>
<td>5.1%</td>
<td>Emotional Control</td>
<td>3.5%</td>
</tr>
<tr>
<td>Emotional Control</td>
<td>5.2%</td>
<td>4.9%</td>
<td>4.6%</td>
<td>Time Management</td>
<td>2.8%</td>
</tr>
<tr>
<td>Time Management</td>
<td>2.4%</td>
<td>2.2%</td>
<td>2.0%</td>
<td>Motivation/Passion</td>
<td>1.6%</td>
</tr>
<tr>
<td>Motivation/Passion</td>
<td>1.0%</td>
<td>0.8%</td>
<td>0.6%</td>
<td>Positively Managing Mistakes</td>
<td>0.6%</td>
</tr>
<tr>
<td>Positively Managing Mistakes</td>
<td>0.6%</td>
<td>0.4%</td>
<td>0.4%</td>
<td>Imagery/Visualization</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

Note: A rating of 1 signifies not difficult and 10 very difficult. A total of 24 mental skills were rated.

COACHING IMPLICATIONS

Coaches Opinions about Mental Skills Training: Five Opinions Most Agreed Upon
1. Players of all levels and abilities need mental skills training; but how this material is packaged may change with experience and player ability levels
2. Male and female players are different emotionally and because of this may react in a different way to the same situation.
3. Coaches must practice mental skill themselves if they are to have confidence teaching them to junior players.
4. Mental skills should be emphasized to a greater degree as players become more intense/competitive.
5. Coaches must be better taught how to detect and analyze player mental skill needs and abilities.

Types of Materials/Resources that are Most Helpful in Teaching Mental Skills to Junior Players: Five Most Useful
1. Mental skills, drills, and exercise forms
2. Mental skills training video
3. Junior tennis mental skills training book
4. Video showing coaches giving mental skills talks and leading exercises
5. Book explaining mental skills, drills, and exercises

REFERENCES / RESOURCES


Taylor, J. 
of Alpine/Taylor Consulting

This research was funded by the USTA Sport Science and Medicine Research Grant (1997)

INTRODUCTION

The purposes of the project were the following:

• To build on the value offered to players, parents and coaches by the educational programs currently presented at the USTA 12 Zonal Championships.

• These programs have been given by experts in the field of sport psychology and tennis, and have been well-received by the tournament attendees. However, there has also been feedback that the information provided at the different Zonals has not been consistent.

• In addition, emphasis in the programs has been more on the personal development of the players and less on an introduction to the aspects of sport psychology that are more commonly associated with performance enhancement.

• This summary reviews the purposes and rationale for the study as well as covers a selection of topics covered in the Be the Best You Can Be: Winning in the Game of Tennis and Life program developed for the USTA 12 Zonal Championships.

GOALS OF THE STUDY

The following are excerpts from the updated sport psychology program presentation: Developing the Mental Edge for Competitive Junior Tennis

• Prime Tennis: Playing at a consistently high level under the most challenging conditions.

• A, E, F & I will determine whether or not you play Prime Tennis.

Attitude
• Believing in your physical, technical, and mental abilities.
• Knowing you can play your best consistently.
• Responding positively to adversity and pressure situations.
• Walking the walk and using positive body language.

Effort
• Giving your best effort in all aspects of your tennis training: physical, technical, tactical, and mental.
• Being totally prepared for every match.
• Never giving up, no matter what the score is.

Focus
• Focusing only on the present, not they past or future.
• Focusing only on the process of playing well, not the outcome of you do play well.
• Focus on the progress you are making, not comparing yourself to others.

Intensity
• Knowing your prime intensity.
• Maintaining prime intensity during practice.
• Adjusting your intensity as needed during matches.

WHAT DID THE STUDY FIND

YEAR PERFORMED 1997

COACHING IMPLICATIONS

• The updated sport psychology educational program will provide clearer and more depth information that will have practical value to your players as they enter the USTA Player Development system.

• These benefits will include a greater understanding of how tennis can impact your players as young people and what psychological information and skills can be used to improve their quality their training and competitive performances.

• The revised program will also benefit parents new to tennis by educating them about their influence (both positive and negative) on their children’s development as athletes and people.

• Both of these advantages will have long-term value in players’ pursuit of their competitive and personal goals, and to the USTA in terms of more mature players who are better prepared for the rigors of high level junior-elite tennis competition.
Retaining Participants in the Sport of Tennis: A Literature Review and Evidence-Based Recommendations

Annessi, J.J.
Rutgers University

This research was funded by the USTA Sport Science and Medicine Research Grant (1998)

INTRODUCTION

• Tennis had recently experienced a decline in participation in the United States at the time of this project (1997/1998). Because of this phenomenon, the United States Tennis Association sought direction ways for promoting participation in the sport, especially at the initial levels of competence.

• While a well-coordinated effort to seek out new players and provide them with basic instruction and play was already present, these activities may have had limited in their ability to maintain participation in the sport.

PURPOSE

• The purpose of this project was to review past research on individuals’ maintenance of participation in sport (i.e., theories of sport participation and research studies on sport continuation/dropout – for both general and youth populations).

• With this task completed, the second goal of the project was to suggest specific techniques that coaches and other practitioners could use to help increase retention of their players in the game of tennis.

RESULTS

In terms of continuation within a sport, the following conclusions were made from the review of past literature:

• Players seek to develop competence and mastery over their skills, while minimizing risks (e.g., failure or loss).

• Perceptions of self-confidence are important and are linked with perceived ability.

• An emphasis on internal and self-directed (intrinsic – satisfaction of skill improvement) motivational factors encourages continued participation, while an emphasis on external (extrinsic - trophies) factors discourages participation.

• Different individuals (e.g., introverts and extrovert, males and females) will appraise the same situation or series of events in different ways.

• The presence of social and fitness aspects support continuance with a sport.

YEAR PERFORMED 1998

COACHING IMPLICATIONS

Mastery/Intrinsic Motivation

• Promote a mastery-based tennis climate; redefine success to include positive outcomes other than winning. This will promote the perceptions of success in the forms of skill improvement, being persistent, or having fun.

• Provide simple skills evaluation tools so that new players may easily track their progress.

• Introductory lessons should minimize verbalized instruction (from coaches to players) and emphasize guided trial-and-error learning.

• Adults should receive follow-up phone call(s) after the initiation of instruction. Scripts should be developed to promote skills mastery as the primary goal and minimize perceptions of threat (e.g., negative evaluation from peers, spectators, coaches, etc.).

• Ensure that young players’ practices and games are fun by catering to children’s shorter attention spans, incorporating change-of-pace within practices, maximizing participation, and increasing action in practice by altering rules and/or equipment.

• Allow players a say in the design of practices, including timing and assessment methods.

Players’ Goals

• Place emphasis on players’ personal goals and be sure these goals are divided into short-term (incremental) goals and are specifically tracked over time.

• Reward short-term goal achievement.

• Provide ongoing feedback regarding players’ goals.

COACHING IMPLICATIONS (cont)

Maximize Self-Confidence and Minimize Threat

• Focus on strengths as opposed to weaknesses, provide effective models (e.g., players that are similar to yours, skilled athletes, etc.), and emphasize that persistence is as important as ability.

• Introductory lessons should be formatted to reduce potential social evaluation (e.g., through frequent player “rotations”).

• Competition should not be a necessary goal for all new players. Allow players to choose when to begin competing, and recognize that some players will never move onto this stage.

• Motivations to participate differ among players. Use surveys to determine what motivates your players so you can organize practices to best engage and inspire the athletes.

• Modify game rules, equipment, and the court during practice to increase perceptions of success. These modifications can minimize an often difficult and frustrating learning process.

• Help alleviate anxiety by decreasing players’ uncertainty and by helping to reduce the importance of competitive outcomes.

• Create an environment that reduces a fear of trying new skills and an atmosphere where ridicule is not tolerated.

Social Aspects of Tennis for Youth Players

• Place emphasis on players’ personal goals and be sure these goals are divided into short-term (incremental) goals and are specifically tracked over time.

• Perceptions of self-confidence are important and are linked with perceived ability.

• Different individuals (e.g., introverts and extrovert, males and females) will appraise the same situation or series of events in different ways.

• The presence of social and fitness aspects support continuance with a sport.

REFERENCES / RESOURCES


Increasing Athletes’ POWER to Solve Problems

Brylinsky, J. & Frauenknecht, M.  
Western Michigan University

This research was funded by the USTA Sport Science and Medicine Research Grant (1998)

INTRODUCTION

As a response to the increasing number of young elite athletes who withdraw from sport competition, a study was conducted that evaluated the effectiveness of a social problem-solving (SPS) program specifically designed to help young tennis players deal with stress.

SPS is a process in which an individual attempts to brainstorm a variety of potential solutions to a problem or stressor that he or she encounters in daily life. Young athletes can apply this coping strategy to address difficult and recurring situations that occur in competitive athletics as well as other problems that typically arise outside of sport.

PURPOSE

The purpose of this project was to develop, carry out and measure the effectiveness of a social problem-solving (SPS) program titled the POWER Problem Solving Curriculum. The POWER module included the following steps:

• Problem identification
• Option generation
• Weighing consequences
• Enacting a plan
• Reflecting and Recycling

The project was conducted over three phases.

• The first phase investigated the relationship between certain health markers (e.g., injury, emotional health, and nutritional health) and SPS using a sample of 173 male and female Western Section players (the majority were 12 and 13 years old (69%)).

• The second phase used the data from the first phase to create the POWER program that was later implemented and assessed in the third phase with 139 male and female tennis players enrolled in the Western Section player development program (ages 10 to 14 years).

RESULTS

Phase One Results:
• - The greatest health risks for players were in the area for emotional health (66.2%).
• - About one of four players reported that it was very hard to deal with stressful situations in general, and specifically in stressful tennis situations.
• - One of every five players indicated they felt they had nothing to look forward to during the past month, and 13% reported wanting to quit playing tennis during the last season.
• - Players who had higher social problem-solving (SPS) scores also reported better use of various health behaviors.

Phase Two Results:
• - Overall, players scored high in their belief that SPS was important.
• - On the other hand, players scored low on the SPS skills of Problem Identification, Option generation, Weighing consequences, and Enacting a plan.
• - These results were used to develop the curriculum for the training program for phase three.

Phase Three Results:
• - Players who completed the POWER Problem-Solving Curriculum significantly increased their SPS skills.
• - More specifically, improvement was observed in Problem Identification, Weighing consequences, Enacting a plan, and Reflecting and Recycling

COACHING IMPLICATIONS

• It appears that the players were able and willing to use the social problem-solving (SPS) skills provided in the POWER training program.
• The most effective problem solvers learn to either focus on the next most positive aspect of the situation or use the POWER model to reduce unpleasant emotional responses to a conflict.
• The six-module POWER program addressed deficiencies in SPS skills that would limit the use of effective coping strategies.
• The program seemed especially useful for addressing emotional health concerns (e.g., tennis related and general stress) and injury prevention issues that were often enough to be out of players’ control.
• The first step of the POWER program, Problem Identification, or correctly identifying the source of stress as a problem, is critical to the total SPS process.
• In some cases, stress is reduced by correctly labeling the original source of conflict as not being a problem because it has no meaningful outcome or major disruption for the player.
• Learning to take a different perspective or be an active listener (through the Option generation step) prompted more creative potential solutions to daily hassles.
• Once players brainstorm creative options, being able to Weigh or predict outcomes of potential solutions (the third step of the program) may reduce wasted time and energy used to pursue unrealistic or negative coping strategies, especially health-compromising behaviors such as trying to ignore stress.
• The Engage in a plan component of the POWER model teaches athletes to use a series of realistic questions such as “who, what, when, where and how” to plan and implement potential solutions.
• Players who systematically Reflect and Recycle through the coping process are better able to evaluate the progress of their coping plan by returning to the initial steps of the POWER model.
• Finally, the study concluded that USTA player development coaches could successfully implement a SPS curriculum during regularly scheduled training meetings.
• For SPS to be most useful for players, however, the coaches who teach the strategies must believe SPS is beneficial in helping young players deal with stress both inside and outside of the tennis environment.

REFERENCES / RESOURCES


INTRODUCTION

- Quick movements requiring fast and accurate reactions to one’s opponent are important in almost all shots in tennis, especially the return of serve and volley.
- In these strokes, the time to react varies depending on factors such as the speed of the ball and the closeness of the opponent.
- The ability to “read” an opponent’s shots increases a player’s readiness to respond, reduces the time of a player’s response, and results in improved performance.
- While it is assumed that skilled players are good at “anticipating” the movements of their opponents, there is little research based evidence that athletes’ speed of reaction is faster when visual information gathered before ball contact (e.g., an opponent’s stance, movements, or position on the court, a ball’s trajectory, etc.) is available.
- Also, little is known of the types of visual information that is needed and that skilled players tend to use to make appropriate and successful responses during play.
- This research project was conducted in two parts to address these two issues.

PURPOSES

- To determine whether skilled tennis players were able to use pre-ball contact visual information from their opponents’ movements to react more quickly and accurately than when they volleyed balls projected by a ball machine or when the players were placed in a laboratory experiment that tested a non-tennis related reaction time task.
- To determine the types of visual information the players used to anticipate the stroke type used by the opponent and the direction of the resulting ball flight.

RESULTS

Experiment 1:
- 9 players from a top ranked collegiate tennis team
- National Tennis Rankings: 6.0 (n = 1) and 7.0 (n = 8).

Experiment 2:
- 12 male tennis players
- National Tennis Rankings: 5.5 or above

- Players were able to react more quickly when they could see the movement pattern of their “opponents” as opposed to conditions in which they were fed balls by a machine.
- Reaction times were reduced by about 25% when they could see the actions of their opponents.
- Players’ reactions in the tennis environment were much faster than reactions in the laboratory experiment.
- Even when balls were projected by the machine, reaction times were significantly faster than the lab reaction time task.
- These results may have been due to the large amount of specific practice players have with on-court tennis tasks. Pushing buttons in response to a stimulus light most likely was not a task these players had regularly practiced before the experiment.
- Players were able to consistently (greater than 50% of the time) anticipate stroke type (i.e., passing shot versus lob) and stroke direction (down-the-line versus cross-court) from their opponents’ movement pattern before ball contact.
- Ball direction was more difficult to anticipate than stroke type.
- It appeared that visual information about the racquet and lower arm was used to determine the type of stroke that was used by a player.
- This conclusion was reached because elimination of this information (i.e., when participants could not see the racquet and/or the lower arm of the video recorded player) caused anticipation accuracy to drop, while elimination of other aspects of the players’ movements (e.g., upper arm or trunk) had no influence on anticipation accuracy.
- Missing visual information of the various body segments and the racquet had no influence on the anticipation accuracy of ball direction.

OVERALL PROJECT METHOD

Experiment 1: Players were asked to volley balls hit by a live “opponent” or delivered by a tennis ball projection machine. Reaction times were measured as the time between when the ball was hit by the “opponent” or projected from the ball machine and when the players first moved their racquets in response to the hit/projected balls. The players also participated in a reaction time laboratory experiment in which they were asked to push a button with their right or left hand in response to the flashing of one of two (left or right) lights on a table in front of them.

Experiment 2: Video recordings of skilled tennis players hitting a down-the-line passing shot, a down-the-line lob, a cross-court passing shot, and a cross-court lob from the baseline were shown to a group of 12 male tennis players (with National Tennis Ratings of 5.5 or above). The recordings of each shot were edited so that portions of the recorded players were not visible to a viewer. More specifically, for each of the shots described above, clips were created under the following five conditions: 1) no visible racquet, 2) no visible racquet and lower arm, 3) no visible upper and lower arm, 4) no visible upper arm and trunk, and 5) no visible lower body. The participants watched a life-size image of the players projected onto a screen across court and were asked to move in the direction they believed the ball was hit by the projected player. Players’ reaction times in each trial were also measured in this portion of the study.

RECOMMENDATIONS

Visual information of an opponent’s movements is important for your players to be able to move more quickly and accurately respond in many competitive situations.

- Practicing with live opponents versus a ball feeding machine will help your players learn to look for and respond effectively to these visual cues.
- You can help your players by drawing their attention to the use of visual information by explaining the types of cues they should be looking for and what this information may indicate in terms of their opponent’s shots (e.g., the depth of a given shot).

For your players’ to gain the most advantage from observing opponent-movements, direct their attention to their opponents’ lower arm and racquet movements.

- This information appears to be useful for anticipating the depth at which a particular shot will be hit.
- While this study did not find visual information from an opponent’s upper arm lower body, or trunk to be as useful for predicting and anticipating resulting shots, information from these body segments may be useful for certain individuals. Do not discourage your players from attending to these areas if they provide useful information to the athletes.

CONCLUSION

This study demonstrated that skilled players use visual information from their opponents’ swing to help them react quickly for shots like the volley. The results also showed that the racquet and lower arm provide the critical information about the stroke that was hit. However, more information is still needed about issues such as player reaction times in competitive situations and the effectiveness of training regimes used to teach players to use pre-contact visual information.

YEAR PERFORMED 1998
INTRODUCTION

• As standards of beauty have increasingly emphasized thin bodies and low body weight, concerns about appearance, weight, and eating have become widespread in the United States and other Western countries.

• Recently, researchers and therapists have focused attention on disturbances in eating and body image in particular groups of women, including female athletes. While tennis is not among the “lean” sports in which success is obviously linked to appearance and/or weight (e.g., gymnastics, figure skating, and wrestling), almost no research has focused on or even discussed female tennis players as a group at risk for eating disorders and abnormal concern with body image.

• However, an increase in media attention on the weight and appearance of female tennis players suggests that these players may also be at risk of focusing excessively upon the appearance of their bodies. This project aimed to fill this void in the literature by investigating the weight-related concerns of competitive junior women tennis players, their parents and their coaches.

PURPOSE

The purpose of this project was to investigate the following questions:

• Do female players and their mothers both believe that weight is important to them?

• What is the relationship between players’ body composition, their self-esteem, and their perceptions about their bodies?

• Is there a relationship between female players’ and their mothers’ body composition, eating behaviors, and self-concept (the way one views oneself)?

• What is the status of tennis coaches’ knowledge about obesity and eating disorders in sport?

SAMPLE

• Participants for this study were 72 junior women tennis players (ages 8 to 23 years), who on average began playing tennis at 7 years of age and began receiving professional coaching at age 9.

• In addition to the players, other participants for the study were parents of these players (47 mothers and 24 fathers) and the players’ coaches (25 males and 7 females).

METHOD

• While attending one of two tennis tournaments, the participants responded to questionnaires concerning their attitudes toward weight, eating, and tennis.

RESULTS

• Most of the players and parents appeared to have reasonable eating patterns, normal self-concepts, and healthy attitudes about tennis.

• This group of participants was most likely somewhat healthier and more fit than a random sample of Americans of those ages.

• However, players and parents were concerned about their weight, and players, mothers, and coaches all wished to be thinner than they were.

• Coaches considered weight-related issues important but were not highly knowledgeable about them.

• Several results implied that weight concerns were more important for females than males.

• Overall, the findings suggest that, rather than applying the results to all female players, issues of weight concern and eating behaviors in women tennis players should be considered on an individual basis.

CONCLUSION

• It is important for you to be aware of the signs and symptoms of excessive body weight concerns and eating disorders and to establish relationships with your players so that conversations about the issues can comfortably take place if needed.

• Also, be aware of professions in your community to whom you can refer your players if it is discovered that an individual has a case that requires expert and specialized attention.

YEAR PERFORMED 1998

RECOMMENDATIONS

• The results of this study suggest that the issues of weight concerns, body image, and eating disorders in athletes should be approached with care.

• Some adolescent female players seem to have reasonably healthy attitudes and behaviors with respect to weight, whereas others may display behaviors that indicate an excessive concern with weight and body image.

• Issues of weight concerns and eating disorders needs to be addressed individually with each of your players.

• Players, parents, and coaches should be aware of the possibility that a normal concern with appearance could develop into an abnormal focus on weight.

• You should not assume, however, that eating disorders are common to everyone.

• In many ways, most of the players, parents and coaches in the present study held appropriate views of tennis as a part of life rather than its focus and of weight as only moderate in importance.

• The coaches, in particular, were aware that not all players share these views and that female players may be at an increased risk for the development of eating disorders.
Fostering and Maintaining Motivation among Urban Youth Tennis Players

Fry, M.D., and Newton, M.
the University of Memphis and University of New Orleans

This research was funded by a USTA Sports Science and Medicine Research Grant (1999).

INTRODUCTION

• It has been suggested that players’ levels of motivation are greatly affected by the athletes’ tennis-related goals. This idea holds especially true when you consider the goal of ‘success’ and the various ways in which athletes judge their ability on the court.

• In general, athletes tend to judge success either with a task- (e.g., according to personal standards) or goal- (e.g., according to comparisons with others’ abilities)-oriented perspective.

• The goal orientation that a player adopts is often influenced by his or her tennis environment and its motivational climate. Task involving climates (e.g., where focus is placed on the tennis process; success is viewed as trying hard and improving; and mistakes are seen as a part of learning) tend to encourage task-oriented goals.

• On the other hand, ego-involving climates (e.g., where the focus is on competitive outcomes; success is viewed as outdoing others and achieving without effort; and mistakes are punished) tend to encourage goals that are more ego-oriented in nature.

PURPOSE

• This project was designed to examine the motivational levels of young urban / players in response to their participation in tennis programs funded by the USTA’s Star Search Grants. It is hoped that this information will help optimize the tennis experiences of these athletes.

• There were several main purposes of this study. A few of these were to:
  a) internal motivation
  b) attitudes toward sportsmanship
  c) the perceived quality of players’ relationships with their teammates and coaches.

SAMPLE

• Participants for this study were 168 players (101 males and 67 females) who ranged in age from 12 to 19 years (with an average age of about 14 years).

• The ethnic make-up of the participants was diverse with players of African-American (48%), Caucasian (23%), Asian/Pacific Islander (14%), Hispanic (10%), and American Indian/Alaskan Native (2%) heritage represented in the sample.

• On average, the young athletes had played tennis for 3.86 years and currently played about 5.18 days per week. Interestingly, the majority (68.7%) of the participants planned to play competitive tennis in the future, and most players wanted to continue to play tennis for fun (81.5%)

METHOD

• The players completed a series of surveys to examine topics such as background information, goal orientation, perceived ability, and attitudes toward sportsmanship.

• Interviews with several Star Search program directors were also conducted to gain information about the various tennis programs and program participants.

RESULTS

General Program Evaluation:

• Results suggested that the Star Search programs had been successful in exposing underserved youth to tennis in an environment that allowed them to thrive.

• Also, these programs were likely to foster players’ interest and continued involvement in the sport.

• Players reported they enjoyed, tried hard, and supported sportsmanlike behaviors in tennis.

• Players also believed high-effort leads to success in tennis and important purposes of the sport include improving technical skills, enhancing self-esteem, and encouraging physical activity throughout life.

Motivational Climate:

• Players who reported having instructors who established a task-involved tennis climate also reported strong enjoyment and interest in tennis.

• Players who felt they were a part of an ego-involving environment reported greater pressure and tension in their tennis experiences.

Goal Orientation:

• Players with high levels of task orientation and low levels of ego-oriented goals reported greater enjoyment of and interest in tennis.

SPORTSMANSHIP:

Players in a high task-involving climate were more likely to approve of sportsmanlike behaviors than players who felt they were in low task-involving climate. The opposite was true for players in high and low ego-involving tennis climates.

Quality Relationships with Teammates and Coach:

• When players perceived a high task-involving climate they liked playing for their tennis pro, felt he/she knew a lot about tennis, and wanted to have the same tennis pro the following year.

• Also, these players reported liking their tennis pro and the other players in their program more, felt the tennis pro liked them, and felt their parents liked the pro more than players who were involved in a low-task involving climate.

• Players from high ego-involved tennis climates reported not liking their tennis pro, not wanting to play for him/her the following year, feeling the pro did not like them, liking tennis less the current year as compared with previous years, and believing their pro was not very knowledgeable about tennis.

RECOMMENDATIONS

• In order to foster high enjoyment, interest, effort, and high levels of commitment in young tennis players, you need to create an environment that emphasizes the athletes’ effort, improvement, cooperation with teammates, and each player’s individual contribution to the team.

• Players in this environment are more likely to seek out extra court time, tough competition, and knowledge about physical fitness and nutrition because they are playing tennis for the love of the game and not for other purposes such as trophies and praise or confirmation from others.

• This environment (as opposed to one that encourages players to focus on their performances in comparison with their peers and a win-at-all-costs attitude) is also more likely to encourage sportsmanlike behaviors in players.

• It is important that you help your players define success in terms of personal effort and improvement rather than a win over the competition.

• Because every child can demonstrate high effort and personal improvement, such a goal perspective (i.e., task orientation) allows that every child can feel successful, which should be a major objective of youth sport programs.

• Instituting a code of sportsmanlike conduct with your players will encourage the athletes to ask questions like “Why are these guidelines important?” and “How do these guidelines make the game of tennis more fun and fair to everyone who plays?”

• Tennis players who follow a code realize the ‘game matters’ and sometimes correct on-court behavior is not in their best interests (in terms of score), but what is best when considering the integrity of the game.

CONCLUSION

• Results of this study indicated that having a task-involved climate resulted in the young players having a greater liking for and respecting their tennis pros. This positive relationship can lead to the athletes exerting more effort, enjoying the tennis program, optimizing their potential on the court, and continuing tennis participation in the future.

• In addition, tennis pros/instructors in these programs (and with these positive coach-athlete relationships) would get more enjoyment from their job because of working with players who have positive attitudes.

• Parental support (which was reported from players in the task-involved programs) of tennis professionals is another critical factor in maximizing the motivational levels of young players.

YEAR PERFORMED 1999
INTRODUCTION

• In a previous study, as part of this line of research, it was discovered that parents considered tennis to be a family activity; however, they had a few major concerns, among them being pressure placed on their children to achieve ranking and recognition.

• Junior tennis was referred to as a “pressure cooker” for the players. Additionally, parents wanted to know what other families were doing and if they shared similar points of view.

• Most importantly, parents were asking for a venue to voice their opinions. They wanted advice on how to relieve pressure, how to deal with costs, and what can be done to improve the tennis experience for their children.

• This project was a response to these concerns and parental needs, which explored the following issues:
  - The extent of pressure put on players and the source of the pressure
  - The benefits and sacrifices to play competitive tennis
  - What specifically were the positive and negative aspects of junior tennis for players and their parents
  - The effect of tennis, both positive and negative, financially and emotionally, for players and parents

PURPOSE

• The purpose of the project was to tap the concerns, issues, and attitudes of the players and parents involved in competitive junior tennis.

SAMPLE

• To gather this information, a survey was sent out by direct mail to over 1,000 of the US's ranked junior tennis players in January of 1998.

YEAR PERFORMED 1999

METHOD

• Responses collected from the direct mailing were surveys from 496 players and 476 parents.

• Of the players, 57% were boys and 43% were girls, with 25% of all players competing in the 14s division, 38% playing in the 18s division, and 37% playing in the 18s division.

• Of the 467 parents, 72% were players themselves, with 97% reporting being moderately to extremely involved in their child’s tennis and 40% spending over 20 hours a week on their child’s tennis activities.

• Responses collected from the direct mailing were surveys from 496 players and 476 parents.

RESULTS

Player Profile

• Players report that the three main positive aspects of tennis are it gives them self-confidence, teaches them how to handle pressure, and teaches them how to focus.

• When asked to choose the number one choice of what players like best about tennis, 68% reported they liked the challenge of competition.

• When asked to choose what players dislike most about junior tennis, 40% disliked poor sportsmanship from other players, 32% disliked the pressure to win, and 19% disliked other players’ parents.

• 75% of the players feel they make personal sacrifices to play tennis, with 19% reporting they lacked a “normal” teenage life.

• Despite the sacrifices, 97% of the players believe that junior tennis is a worthwhile activity.

Parent Profile

• The number one item that parents liked most about junior tennis is the fact that they enjoyed the competition among the players. Parents also reported that tennis teaches their children how to handle victories and defeat (25%) and how to handle pressure (21%).

• Parents chose various answers for why they dislike junior tennis including pressure to win (38%), lack of sportsmanship among players (31%), and less time for school work (26%).

• Parents report that the primary benefit they personally receive from involvement in their child’s tennis is knowing that their child benefits from the experience (62%), and that it creates a closer relationship with their child (39%).

RESULTS (cont.)

Tennis and the Family

• Despite players and parents reporting that tennis causes some minor problems in their households, 99% of parents and 98% of players report that tennis is a worthwhile and fulfilling experience as a family.

• Both parents and players agree that junior tennis creates a closer family relationship and consider it to be a positive experience.

Cost of Tennis

• 83% of parents spent over $10,000/year (in 1998) on tennis with 36% spending over $20,000/year. Parents, regardless of income, report that tennis is “outrageously expensive” with 75% mentioning it is a financial hardship on the family.

Pressure on Players

• Parents are highly concerned about the pressure on their children to perform. 68% of parents report that they “never” or “rarely” put pressure on their children because of their financial or emotional involvement. 52% report that they “sometimes” put pressure on their children.

• Players agree with parents in that 85% of players feel their parents put “none” or “a little” pressure on them to play. 5% report parents place “a great deal” and 10% “often” place pressure on them to play.

• On the contrary, an overwhelming 97% of players report they place pressure on themselves to win.

Top 10 vs. Other Players

• A key distinction among the parents is that top 10 parents have clear, high aspirations for their children when they initially become involved in tennis. They also realize more than other parents (75% vs. 59%) when they first became involved in junior tennis the amount of time effort competitive tennis takes.

RECOMMENDATIONS

• To help make junior tennis an enjoyable and meaningful experience for your players, be sure to draw their attention to the aspects of participation that were cited as being the most positive for the players in this study.

• More specifically, make sure that your instruction includes the development of your players’ self-confidence (e.g., positive feedback, encouragement, providing opportunity for success in practice and competition), instruction on ways players can best handle pressure (e.g., simulating competitive situations in practice, keeping winning in perspective, defining and having plans to combat obstacles), and focusing strategies, (e.g., centered breathing and strategies for dealing with distractions such as other players’ and parents’ poor sportsmanship).

• Also, try to help your players’ view competitions as exciting challenges and opportunities for success instead of pressure filled opportunities for failure.

• Try to help your players’ put the sacrifices they make for tennis into perspective. Discuss the types of dedication and commitment needed for success, but also make sure that players are able to balance tennis with other aspects of life. Failure to do so could lead to burnout and players’ dropping out of tennis altogether.

• Tennis parents take pride in and enjoy being involved in their child’s tennis career.

• Allow for parent involvement that does not interfere with your coaching practices or decisions or the players’ enjoyment of the sport.

• Establishing open communication with players’ parents will help create these balanced relationships as well as make it easier to adjust parental involvement if necessary.

CONCLUSION

• The tennis system is an area where pressure is evolving. The cost of tennis, as well as few major national tennis tournaments place an unusual amount of pressure on players to achieve rankings. Further, recognition from the USTA and scholarships are dependant upon the ranking system.

• Parents need to help your players’ place these demands in perspective and make sure much of their focus is on skill development and fun.
Athletic Perceived Competence and Self-Evaluation Processes in Adult Tennis Players

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This research was funded by a USTA Sports Science and Medicine Research Grant (2001).

INTRODUCTION

• Perceived competence is related to expectations for the future, which is often the motivation for practice, effort, and participation.
• If players feel confident about their tennis ability, they also will think they have the potential to be good in the future, which would require practice, effort, and continuation of tennis participation.
• If players think they’re not at all good at tennis, then they are likely to think they are not going to play well in the future, which could make players frustrated, stop trying, and/or give up the sport forever.
• In order for tennis players to figure out how good they are, they must decide to which sources of information they must pay attention (e.g., win/loss record, position on the team, improvement, feedback from coaches, or personal goal achievement).
• People often use multiple sources of self-evaluation information, yet some sources may be more important for certain types of people based on factors such as age and gender.
• The ways in which individuals assess their competence as tennis players is essential for you to understand if you are to positively affect your athletes’ development.

PURPOSES

This study had two main purposes:
• To determine if tennis players consider psychological factors when they determine how good they are at tennis and if these athletes place more importance on physical or psychological skills when doing so.
• To find out if athlete gender and/or perceived tennis ability played a role in the various sources of self-evaluation used.

SAMPLE

Participants for this project were 467 tennis players from 15 tennis facilities in a Midwestern state.
- Gender: females (n=323), males (n=143)
- Age Range: 19 to 74 years
- Ethnicity: Caucasian (90%), African-American (4%), Asian American (2%), Hispanic (2%), N/S (1%)
- USTA Rating: 2.5 (n=28), 3.0 (n=136), 3.5 (n=162), 4.0 (n=69)
- 4.5 (n=48), 5.0 (n=17), 5.5 (n=1)

PROJECT METHOD

Participants completed a series of questionnaires that measured different physical (e.g., strength, endurance, and flexibility) and psychological (e.g., coping with adversity, peaking under pressure, and concentration) variables along with players’ USTA ratings, age, perceived tennis shot abilities and overall perceived tennis competence. The results of the surveys were used to address the study purposes in two separate investigations.

RESULTS

Investigation #1

Of the 12 psychological and physical variables that were studied, 5 were related to players’ perceived tennis competence (presented in the order of most strongly predictive to least strongly predictive):
- USTA Rating
- Perceived Tennis Shot Abilities
- Age
- Confidence and Achievement Motivation (e.g., play to beat others vs. play to test one’s abilities), and
- Strategy Knowledge.

Because gender differences have been found in perceived competence in past studies, separate analyses were then performed for male and female players.

Predictors of Perceived Tennis Competence for Women
- Predicted tennis shot abilities
- Age, and
- USTA Rating

Predictors of Perceived Tennis Competence for Men
- Perceived tennis shot abilities,
- USTA Rating,
- Confidence and Achievement Motivation, and
- Strategy Knowledge

Investigation #2

This portion of the project investigated how gender and level of perceived tennis competence influenced the sources of information players used to determine their self-perceptions of tennis competence.

Female players were more likely than males to utilize the following sources of information:
- Personal Improvement Information
- Feedback from Coaches/Instructors
- Feedback from Teammates
- Personal Attraction to the Sport, and
- Degree of Perceived Effort

Male players were found to use comparisons with peers slightly more often than females.

Players with High Perceived Tennis Competence were more likely than those with Moderate or Low Perceived Tennis Competence to utilize the following sources of information to draw conclusions about their competence in tennis:
- Objective Measures (i.e., personal statistics),
- Personal Assessment of Performance,
- Feedback from Spectators,
- Comparisons with Peers,
- Feeling Nervous and Excited, and
- Degree of Effort Exerted.

Players with High Perceived Tennis Competence were slightly more likely to use ‘Reaching Personal Goals’ as a source of information than athletes with Moderate or Low Perceived Competence.

Interestingly, there were no significant differences in the sources of self-evaluation between players of Moderate and Low Perceived Tennis Competence.

CONCLUSION

Because perceived competence relates to motivation, it would be beneficial for you to always try to help increase your players’ self-perceptions of their tennis ability. It is also critical for you to understand what sources of information players use to determine this sense of competence so you can best optimize these self-perceptions. Use the previously mentioned recommendations as a guideline for enhancing players’ beliefs about their competence in tennis, but be sure to assess how each player responds to these practices and make appropriate adjustments based on individual needs and preferences.

YEAR PERFORMED 2001
INTRODUCTION

• It is widely acknowledged that athletes who experience excessive stress often show signs of burnout and perform at lower levels.
• Furthermore, burnout may be associated with dropping out of competitive tennis altogether.
• This study was intended to help junior tennis players recognize and alleviate the signs and symptoms of excessive stress. It was hoped that by teaching a group of players a broad range of coping skills (e.g., relaxation/breathing techniques, thought-stoppages, positive reinterpretation) reductions in stress would be observed.
• It was also hoped that an increase in positive emotions and confidence and decreases in negative emotions and anxiety would occur throughout the course of the intervention.

SAMPLE

• Participants for the study were 5 junior tennis players (3 males and 2 females) with an average age of 11.6 years.
• These players had been competing, on average, for 10 years and indicated that their highest state USTA rankings were between 2 and 347.
• With the exception of the 347th ranked player, all participants were ranked in the top 30 in the state of Florida.

PROJECT METHOD

• The players were interviewed and completed a series of surveys that measured factors such as sport-related confidence, anxiety, coping, burnout, and mood so that the intervention could be personalized to the athletes' individual needs.
• With this information, a six session intervention was conducted with each player over the following four phases:
  (a) the establishment of a warm collaborative relationship between players and the consultant
  (b) education of the underlying principles and philosophy of the program
  (c) coping skills training (e.g., goal setting, imagery, relaxation techniques)
  (d) transferring coping skills to real life situations.

RESULTS

Confidence

• Four of the five participants showed an increase in confidence over the 2 month intervention period.
• All five players indicated they had learned important psychological skills that they felt could be easily applied in tennis competition and practice.

Anxiety

• There were mixed results in the effectiveness of the intervention on competitive anxiety.
• Three players showed increases, while 2 layers showed decreases in anxiety over the intervention period.
• The increases in anxiety could be due to an increased awareness of anxiety symptoms because of participation in the study or players may have been engaged in more frequent and challenging competitions (which could have been more anxiety provoking) at the time of the second assessment.

Mood and Coping

• There was also variability of the use of coping skills and in players' mood over the intervention period.
• This inconsistency could be due to individual needs for coping, responses to individual performance, changes in coping skill awareness, etc.

CONCLUSION

• It was concluded that junior tennis players can benefit from structured psychological skills programs in terms of performance, anxiety, and confidence.
• A minimum of about 10 weeks may be needed to gain substantial effects from the program.
• The participant who seemed to respond most positively to the psychological skills program had participated in a similar program in the past.
• Therefore, prolonged and/or frequent exposure to a program (e.g., integrating the mental skills training into one’s regular tennis training) may lead to increased beneficial effects on players' confidence, anxiety, and overall performance on the court.
• Increasing players’ awareness of coping skills alone may not be sufficient.
• Teaching players to transfer coping skills onto the court and into daily life is an essential component in any psychological skills program.
Understanding the Role Parents Play in Junior Tennis: Phase 1 Focus Groups with Junior Coaches

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University of North Carolina Greensboro²

This research was funded by the USTA Sport Science and Medicine Research Grant (2002)

Introduction

Parents are controversial subject today in youth sport. USA Tennis High Performance coaches frequently report problems with parents including shying away from competition, pressuring, and interfering with coaching.

Yet, coaches recognize that parents are essential to developing the talent of young tennis players. They also have the ability to teach life lessons and skills through the sport.

A paradox exists. Parents need to be involved and yet not too involved where they are detrimental to the experience youth have in tennis.

Little scientific information exists regarding parenting junior tennis players.

Method

Focus group interviews were conducted with 24 experienced junior tennis coaches attending a high performance workshop.

Sample

Who were the 24 high performance junior tennis coaches interviewed?

Average Age: 37 Years of Age (Range: 27-54 Years)
Gender: 22 Male 2 Female
Ethnicity: Caucasian: 20 African-American: 3 (1 coach listed as “other”)
Years Coaching Experience: 14.94 Years Coaching (Range: 4.5-32 Years)
Average Number of Ranked Players Coached:
7.4 Sectionally Ranked Players
4.3 Nationally Ranked Players

Coaches’ experiences with junior tennis parents

•Coaches speculated that 70% of parents or more have a positive influence. However, there is a minority that creates problems and receives a great deal of notoriety.

Why parent problems?

•Parents are demanding and have very high expectations because of the money they pay for their child in tennis,
•In some cultures parents are more apt to become over involved and create negative tennis experiences, and,
•Parents try to coach their own child when they are not trained as a coach.

Positive Parent-Player Interactions

•Top antecedents to positive parent-player interactions
  1. Increase pressure on the player,
  2. Development of player inhibited,
  3. Lack of player motivation, and,
  4. Player distracted on-court.

Positive Parent-Coach Interactions

Topays parents facilitate coaches’ practice

1. Parent need to implement optimal parenting strategies
2. Parent involvement in tennis is needed and important
3. Each parent is different and approach tennis differently
4. Parents place trust in the coach to work with their child

Positive Parent-Player Interaction Behaviors Exhibited by Parents

1. Discipline child for poor behaviors/handles poor behaviors effectively
2. Exhibits a balanced approach, supportive but not overbearing
3. Provide financial support
4. Stay calm and control emotions
5. Sacrifice for child (time, effort)
6. Focus on performance, not the outcome
7. Provide unconditional love and caring

Negative Parent-Coach Interactions

Core Principles Related to the Role of Junior Tennis Parents

Top 4 Parent-Centered Core Principles Related to Role of Junior Tennis Parents

1. Parents need to implement optimal parenting strategies
2. Parent involvement in tennis is needed and important
3. Each parent is different and approach tennis differently
4. Parents place trust in the coach to work with their child

Results, cont.

Other Important Core Principles Related to the Role of Junior Tennis Parents

•The coach-parent relationship depends on the age, experience, & maturity of the coach (older coaches were perceived to be better at developing good relationships with parents),
•Parents need to focus on total child development and life skills,
•Coaches need to empathize and understand the parent, and,
•Coaches should set roles and boundaries for parents and players.

Does optimal push exist?

•The coaches felt that optimal push does exist but only when done correctly and it is a fine line between optimal pushing and pressuring/over pushing.

What does Optimal Parent Push Involve?

Positive Push

1. Reinforcing preparation and hard work
2. Making the child responsible
3. Applying pressure to win or perform

Negative Push

1. Becomes a better person
2. Has enhanced friendships and social benefits
3. Takes a grounded, not above others perspective, and,
4. Has a positive experience.

Top consequences of positive interactions between parents and players

The junior player:

- Becomes a better person,
- Has enhanced friendships and social benefits,
- Takes a grounded, not above others perspective, and,
- Has a positive experience.

What factors influence optimal push?

•Child’s age, gender, and goals,
•Finding the middle ground between pushing and supporting, and,
•The parent and his or her personality.

Coaching Implications

Recommendations for Maximizing the Parent-Coach Partnership

Top 4 Recommendations to Coaches on Working with Tennis Parents

1. Identify and convey clear expectations and goals with parents and players
2. Educate parents and hold parent education meetings
3. Openly and effectively communicate with parents
4. Involve the parents

Top 4 Coach Recommendations to Tennis Parents

1. Talk less to your child about tennis off the court
2. Voice negative issues to the coach not the child
3. Control your reactions to the outcome of the match/treat wins and losses the same
4. Develop the view that my sacrifice for my child’s tennis is normal/don’t expect a return on your investment (or at least don’t express it to your child)

Top 4 Coach Recommendations to the USTA

1. Educate coaches on working effectively with tennis parents
2. Disseminate tennis parent education information to parents via meetings and newsletters/articles

Year Performed 2003
INTRODUCTION

•Parents are controversial subject today in youth sport. USA Tennis High Performance coaches frequently report problems with parents including shying away from competition, pressuring, and interfering with coaching.

•Yet, coaches recognize that parents are essential to developing the talent of young tennis players. They also have the ability to teach life lessons and skills through the sport.

A paradox exists. Parents need to be involved and yet not too involved where they are detrimental to the experience youth have in tennis.

•Little scientific information exists regarding parenting junior tennis players.

PURPOSE

•The study was designed to better understand the role that parents play in tennis success.

Specifically, junior tennis coaches were sampled to identify effective and ineffective tennis parenting behaviors relative to parents’ interactions with players and coaches, and provide strategies to facilitate effective player, coach, and parent partnerships.

The goal of this phase of the study was to generalize the findings from Phase 1 to ensure that the issues raised are relevant to junior tennis as a whole.

METHOD

•A national survey of 300 coaches attending the USA Tennis High Performance Competition Training Center Coaches Workshop in January of 2003.

WHAT DID THE STUDY FIND?

Who were the 132 junior tennis coaches surveyed?

Average Age: Male: 40.5 Years of Age Female: 39.0 Years of Age

Gender: 125 Male 7 Female

Ethnicity: Caucasian: 84.9% African-American: 7.0% Asian: 3.1% Hispanic: 3.1% Years Coaching Experience: 17.3 Years Coaching (Range: 1-50 Years)

Average Number of Ranked Players Coached: 12.1 Sectionally Ranked Players

4.0 Nationally Ranked Players

Importance and Role of Parents in the Development of a Junior Player

Coaches reported that parents are very important to junior tennis success (M = 4.56, on a scale of 1=not important to 5=extremely important).

15.86% of parents were perceived as actually hurting their child’s tennis development.

58.80% of parents were perceived as having a positive influence on their child’s tennis development.

Perceptions of Parent Behaviors in Tennis

Parent-Child Interaction Problem Behaviors

7 “Most Extensive” Parent Problems

<table>
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<tr>
<th>Mean</th>
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<tbody>
<tr>
<td>Overemphasizing winning</td>
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<tr>
<td>Provides logistical support</td>
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<tr>
<td>Provides tennis opportunities</td>
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<tr>
<td>Provides socio-emotional support</td>
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<tr>
<td>Provides unconditional love and support</td>
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<tr>
<td>Make sacrifices so child can succeed</td>
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<tr>
<td>Establish hard work</td>
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5 “Least Extensive” Parent Problems

<table>
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<tr>
<th>Mean</th>
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<tbody>
<tr>
<td>Doesn’t allow child to play doubles</td>
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<tr>
<td>Uninvolved in child’s tennis</td>
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<tr>
<td>Doesn’t allow child to be involved in other sports/activities</td>
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<tr>
<td>Unconcerned with child’s development</td>
</tr>
<tr>
<td>Enters child into too many tournaments</td>
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</tbody>
</table>

7 “Most Important” Ways to Foster Good Coach-Parent Relationships

Communication 104

Trust 103

Cooperation/common realistic goals 38

Respect 31

Honesty 26

5 “Most Important” Ways to Foster Good Coach-Parent Relationships

Communication 104

Trust 103

Cooperation/common realistic goals 38

Respect 31

Honesty 26

Parent-Child Interaction Problem Behaviors

7 “Most Extensive” Positive Parent Behaviors

<table>
<thead>
<tr>
<th>Mean</th>
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<tbody>
<tr>
<td>Provide financial support</td>
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<td>Provide logistical support</td>
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<tr>
<td>Provide tennis opportunities</td>
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<tr>
<td>Provide socio-emotional support</td>
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<td>Establish hard work</td>
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5 “Least Extensive” Positive Parent Behaviors

<table>
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<tr>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide positive feedback following matches</td>
</tr>
<tr>
<td>Exert little pressure to win</td>
</tr>
<tr>
<td>Push child in a positive way</td>
</tr>
<tr>
<td>Use motivational techniques</td>
</tr>
<tr>
<td>Show an understanding of the sport</td>
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</tbody>
</table>

7 “Most Extensive” Positive Parent Behaviors with the Greatest Impact

<table>
<thead>
<tr>
<th>Mean</th>
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<tbody>
<tr>
<td>Provide unconditional love and support</td>
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<tr>
<td>Provide logistical support</td>
</tr>
<tr>
<td>Hold child accountable for behavior on-court</td>
</tr>
<tr>
<td>Provide financial support</td>
</tr>
<tr>
<td>Support child financially</td>
</tr>
<tr>
<td>Emphasize positive attitude</td>
</tr>
<tr>
<td>Model values</td>
</tr>
<tr>
<td>Provide appropriate discipline for poor sportspersonship</td>
</tr>
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</table>

YEAR PERFORMED 2003
INTRODUCTION

Parents are one of the most controversial issues in sport.

Junior coaches from around the U.S. are reporting an increase in the frequency of over-involved parents who pressure their children, interfere with coaching and unknowingly thwart both their child’s love of the game and development of their tennis talent.

Yet Phase 1 study revealed that 66% of parents are positive sources of support.

Parents are a growing concern and yet essential to the development of junior tennis players.

PURPOSE

The study was designed to better understand the role that parents play in tennis talent development and success.

Phase 1 was designed to provide an in-depth examination of general involvement in the development of top level tennis players by retrospectively interviewing outstanding players, one of their parents, and a coach who has a great deal of interaction with the parent during the junior tennis years.

PARTICIPANTS

Nine American-born tennis players, eight of their parents, and eight of their coaches were interviewed.

Each of the players were on the professional tour at the time of the interview.

Selection criteria for being a participant were:

- American-born tennis players who were developed in some capacity by the USTA.
- Talented tennis player on the professional tour or playing some competitive events and highly successful in ITF tournaments.
- Were of close to the same generation/age group.
- Parents and coaches were selected based on the players’ perceptions of the most involved parent and the coaches who knew best the players and were involved during the developmental period.
- Four male and four female players averaged 20.5 years of age and had an average tour ranking of 55.
- Four male and four female parents averaged 58 years of age, 4 competed as a tennis player, and 2 were trained as a coach.
- All 7 coaches were male (one coach worked with 2 of the players) and averaged 47 years with 28 years of experience coaching.
- Players listed their developmental phases according to Bloom (1985).

Bloom (1985) Progressive Phases of Talent Development

Early Years

Middle Years

Elite Years

Patterns of Positive and Negative Behaviors

Early Years

Middle Years

Elite Years

WHAT DID THE STUDY FIND?

Eight Important Positive Parental Behaviors in the Early Years

- Provided Emotional, Logical, and Financial Support
- Provided the Opportunity and Resources
- Provided Push to Play, but Did Not Pressure
- Exhibited Emotional Control
- Emphasized Fun
- Helped Develop Child’s Talents by Hitting with Child (and sometimes coaching)
- Provided Transportation
- Provided Emotional, Logical, and Financial Support

Middle Years

- Provided Emotional, Logical, and Financial Support
- Provided Transportation
- Provided Emotional, Logical, and Financial Support
- Provided the Opportunity and Resources
- Provided the Amount of Push to Practice/Hold High Expectations
- Provided Supplemental Coaching/Instruction
- Kept Tennis in Perspective
- Provided Supplemental Coaching/Instruction

Elite Years

- Provided Emotional, Logical, and Financial Support
- Provided Emotional, Logical, and Financial Support
- Provided the Opportunity and Resources
- Provided the Amount of Push to Practice/Hold High Expectations
- Provided Supplemental Coaching/Instruction
- Kept Tennis in Perspective
- Provided Supplemental Coaching/Instruction

These Important Negative Parental Behaviors in the Early Years

- Were Negative, Yelling, or Angry
- Placed Too Much Pressure on Child, Over Pressed
- Last Healthy, Perspective (sometimes over involved)

Top 9 Recommendations Coaches made to Junior Tennis Parents

1. Look Very Hard, Diligently, and Carefully for a Coach and Stick with Him/Her
2. Help with Off-Court Stuff (e.g., helping with shopping, taking care of details)
3. Important to Have a Life Outside of Tennis
4. Stay Positive, Be Careful with Criticism (must be thought out and done with a purpose)
5. Be Prepared to Practice and Don’t Go to All of the Matches
6. Trust the Coach to Do His or Her Job
7. Maintain a Strong, Stable Family Life
8. Become Less Involved and Allow Expert Coaches to Take Over Child’s Development in Tennis
9. Teach Child to Learn Lessons from Losing

RESULTS, CONT.

Top 9 Important Positive Parental Behaviors in the Elite Years

- Provided Emotional, Logical, and Financial Support
- Provided the Opportunity and Resources
- Exhibited Emotional Control
- Stressful Good On-court Conduct
- Lessened Involvement/Pulled Back Purposefully
- Allowed Child Independence
- Kept Tennis in Perspective
- Provided Consistent and Stable Parenting
- Helped with Professional Career Decisions
- Helped to Make Good Decisions (Give Advice)

COACHING IMPLICATIONS

Each and every parent and child has a unique history with unique personalities that make it impossible to provide a ‘recipe’ to parenting one’s child successfully. Thus, there is no one correct way to parenting one’s child in junior tennis.

Parents who had good relationships with their child at the end of the developmental years had a few core characteristics that made them successful including:

- A healthy perspective of tennis where developing the child and having fun was always more important than winning.
- The use of many types of support and a great deal of it,
- and the ability to understand their shifting parenting role.

Parenting a child in junior tennis is a very difficult and complex process requiring the parent to make sound decisions based on what is best for the child, even when there is pressure to win or to keep up with the rest of the tennis world.

Top 9 Recommendations Coaches made to Junior Tennis Parents

YEAR PERFORMED 2003

25.

25.

25.

25.

25.
The Effect of Congruence of Leadership Behaviors on Motivation, Commitment, and Satisfaction of College Tennis Players.

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This research was funded by the USTA Sport Science and Medicine Research Grant (2005)

INTRODUCTION

• The concepts of leadership, motivation, commitment, and satisfaction have been mentioned as integral components of the sport of tennis by leading practitioners, scholars, and organizations (e.g., ARCTF, 2002; Bollettieri, 2001; Krise, 1997; Weinberg, 2002). Most research on coaching effectiveness has assumed that coaches greatly influence athletes’ performance, behavior, psychological, and emotional well-being. Similarly, Horn (2002) suggested that the behavior of coaches directly influences the motivation, self-perceptions, perceived success, and achievement behavior of athletes.

• Chelladurai’s (1978) Multidimensional Model of Leadership (MML) has been used to study leadership in sport. The MML proposes that three aspects of leader behavior need to be in congruence with one another (match) to achieve effective performance and athlete satisfaction. The aspects of leader behavior include required (behavior that is required for a particular situation), preferred (behavior preferred of the coach by the athletes), and perceived (the coach’s behavior as perceived by the athletes). Furthermore, Chelladurai posited that leader behavior was influenced by the characteristics of the situation, the leader, and the members. In the MML, leadership effectiveness, as defined in terms of congruence between required, preferred, and perceived leader behavior, results in member satisfaction and performance outcomes.

• It has been questioned whether a match (or congruence) positively affects and a mismatch negatively influences an athlete’s emotional state, behavior, and/or performance. This study focused on the relationship between congruence of leadership behaviors and positive outcomes in collegiate tennis players.

PROCEDURES

The purpose of this study was to investigate the potential positive relationships between the congruence of preferred and perceived leadership behaviors with motivation, commitment, and satisfaction of collegiate tennis players. Specifically, the congruence of leadership behaviors was compared with:

- Autocratic (self-directed) and extrinsic (external) motivation,
- Intrinsic motivation (lack of motivation),
- Sport commitment/enjoyment,
- Certain aspects of athlete satisfaction (e.g., individual performance, personal treatment, and training instruction).

PARTICIPANTS

245 participants [78 males (31.8%), 167 females (68.2%)] from 76 colleges participated in this study.

- Age: mean = 20.01 years (ranging from 18 to 24 years)
- Nationality: 78.8% United States, 22.2% one of 33 other countries
- NCAA Division: 1 (42%), II (9.4%), III (48.6%)
- Collegiate Playing Experience: mean = 11.05 years (ranging from 1 to 5 years)
- Singles Playing Position: mean = 4.47 (ranging from 1st to 20th)

RESULTS

Hypotheses

- H1a: The ability level of the collegiate tennis players as defined by NCAA division level will be a determinant of preferred leadership behavior.
- H1b: The gender of the collegiate tennis players will be a determinant of preferred leadership behavior.
- H2: The gender of the collegiate tennis players will be a determinant of preferred leadership behavior.
- H3: Intrinsic motivation will be dependent on the congruence between preferred and perceived leadership behaviors.
- H4: Extrinsic motivation will not be dependent on the congruence between preferred and perceived leadership behaviors.
- H5: Amotivation will not be dependent on the congruence between preferred and perceived leadership behaviors.
- H6: Sport commitment and its determinants will be dependent on the congruence between preferred and perceived leadership behaviors.
- H7: Athlete satisfaction will be dependent on the congruence between preferred and perceived leadership behaviors.

Data Analysis

• Descriptive statistics were calculated for each of the demographic variables.
- Multivariate multiple regression analyses were utilized to determine the effect of demographic variables on leadership behavior preferences.

- This statistical procedure addressed hypotheses H1a, H1b, and H2.
- Multiple Analysis of Variance (MANOVA) was used to assess the effect of leadership behavior congruence on the motivation, commitment, and satisfaction of the athletes. This statistical procedure addressed hypotheses H3, H4, H5, H6, and H7.

Implications and Applications

- The discovery that gender and playing ability did not affect preferences for coaching leadership behavior type contradicted past research (e.g., Boom, 2002; Erle, 1981; Riemer & Toon, 2001) and should be carefully considered. Because these findings may have come about because of the unique sample that was used and/or the way in which playing ability was measured, more research on the topic is necessary to draw more definitive conclusions.

- The results of this study indicated a match between certain preferred and perceived leadership behaviors were related to certain aspects of intrinsic and extrinsic motivation, amotivation, sport commitment, sport enjoyment, individual performance satisfaction, personal treatment satisfaction, team performance satisfaction, and training and instruction satisfaction.

- The leadership behaviors that warrant special attention because of their multiple influences were autocratic behavior and positive feedback. In order to best influence your athletes’ commitment, motivation and satisfaction with tennis, it would be useful to determine the preferences of your athletes and tailor these leadership behaviors and adapt your coaching to meet these needs (keeping in mind the impact of factors like league expectations and policies).

- USA Tennis could also take part in helping optimize the coach-athlete relationship. Rather than selecting athletes to train at its two facilities based on geography and when assigning traveling coaches to athletes on the ATP/WTA Tours, USA Tennis could match prospective athletes with a coach who displays the athlete’s preferred leadership style.

- In summary, the results of this study could have a profound impact on how tennis is taught across the world in a variety of individual and group settings. More attention might be given to matching preferred leadership behaviors of the student and preferred leadership behaviors of the coach to optimize player motivation, commitment, and satisfaction.

YEAR PERFORMED 2005
How Fit are World Class Tennis Players?

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This research was funded by a USTA Sports Science and Medicine Research Grant (1989).

METHOD

The fitness measures that were assessed were:

- flexibility
- percentage of body fat
- cardiorespiratory endurance,
- muscular strength
- muscle endurance
- cholesterol
- power
- agility
- speed using tests such as the sit-and-reach test
- skin fold assessment
- timed push-ups and sit-ups
- grip test
- vertical jump and the
- 20-yard dash.

RESULTS

- Overall, the results of this study indicted that playing tennis, even at the elite level, does not provide complete fitness.

- Eight players completed an injury and training history questionnaire with the following results:
  - Six of the eight players had serious sport-related injuries in the past.
  - Most of these injuries had affected the shoulder, knee, and/or ankle.
  - Seven players stretched either daily or before each match, with only two athletes stretching all major muscle groups.
  - Six of the eight players reported they did aerobic conditioning such as jogging and cycling.
  - Six players said they did strength training consisting of Nautilus, free weights, push-ups and sit-ups.

- Results of the sit-ups and push-ups were within the normal range of the general population.

- Average body fat of the players who participated in this assessment was 6.9%, which is considered lean for 24 year old males (normal college-aged males range from 10.8 to 18.7%).

- The cardiorespiratory endurance test (step-test) results showed an average post-exercise heart rate of 44 beats per minute, which is considered above average.

- Average cholesterol was 159 mg/dL, well under the current recommended limit of 180 mg/dL.

- Tests results for speed (20 yard dash), agility (hexagon test), and power (vertical jump) were in the average range.

- Flexibility of the lower back was found to be 0.5, which is below the average value of the general population.

- Flexibility (range of motion) of the shoulder and wrists were also less than average for the general population.

- In all cases the flexibility of the dominant side of the body exhibited less flexibility than the non-dominant side.

- The average flexibility (range of motion) of the hips was within normal limits except for hip internal rotation.

- Average grip strength of the players’ dominant arms was 48.3 kg which resulted in 63.2% grip strength to body weight ratio.

- More specifically, five of the six players tested exhibited the recommended grip strength to body weight ratios that are greater than 55%.

- Overall, the measures of shoulder also showed sufficient strength in this area; however, the average strength of the hamstrings and quadriceps of the players tested was found to be below recommended levels.

CONCLUSION

- Again, the results of this project lead us to believe that even tennis at the highest level of the game does not provide complete fitness. This study highlights the need for additional cardiovascular, flexibility, and strength training in tennis specific areas to maximize performance and reduce injury.
INTRODUCTION

- Dynamic resistance training programs have been linked with enhanced strength gains in untrained and trained individuals as well as decreases in the risk for soft tissue injuries and increases in general fitness levels.
- There is also some evidence that tennis performance can be maintained or improved through increased strength, muscular endurance, agility, and explosive movements on the court that occur from these same training regimens.
- With the current popularity of resistance training programs and their role in enhancing general sport and specific skill performance, many individuals involved with tennis are interested in a time efficient weight training program.
- Therefore, this study was designed to investigate the effects of two circuit (time efficient) resistance training programs on players' cross-court forehand groundstroke performance.

METHOD

All participants were tested on their forehand drive performance (accuracy and speed) before the nine week training period in.

- The study used three groups of participants in different programs:
  - One-third of the group participated in a mid/lower body circuit program (comprised of the seated leg press, seated toe press, horizontal sit-up, leg extension, leg curl, and reverse trunk twist),
  - One-third of the group participated in a total body circuit program (consisting of the bench press, seated leg press, lat pull-down, seated toe press, seated overhead press, leg extension, horizontal sit-up, leg curl, bicep curl, and elbow extension),
  - The last third of the group did not participate in any resistance training programs (control group).
- Players in the 2 circuit programs trained 3 days a week for a total of 27 (25 to 30 minute) training sessions.
- The intensities of the exercises in both programs were cycled identically throughout the week (60-90%) and gradually increased throughout the training program.
- All participants took part in their regularly scheduled tennis classes during the training period and were then re-tested for the accuracy and speed of their forehand drives at the end of the nine weeks.

RESULTS

- There were no significant differences in the forehand groundstroke performances of the two treatment groups after the training programs.
- There were no significant differences in forehand performance of the treatment and control groups after the training programs.
- The total body resistance training program produced the only significant improvement in forehand performance scores (speed and accuracy) and the speed-accuracy relationship from pre-training to post-training.

RECOMMENDATIONS

- Although this study did not reveal significant differences in performance of the forehand groundstroke between the three groups, the group who participated in the total body circuit resistance training program improved their speed, accuracy and the speed-accuracy relationship of the forehand drive.
- By improving the skill scores and the speed-accuracy relationship, a player would be able to hit a more penetrating shot and/or consistent shot from the backcourt.
- A penetrating shot that has more speed can elicit an un-returnable or weak return shot from an opponent as well as an increased chance the opponent will commit and error (especially from the backcourt).
- The circuit weight training program has the potential to be particularly beneficial because of its effectiveness, time efficiency, and applicability to the club, tournament or school-team player.
- Because training is costly in terms of time, players cannot afford to waste time on activities that will not result in better performances.
- With circuit training (the total body program specifically), positive outcomes occur within a relatively short amount of time (20-30 minutes per session) needed to complete the circuit three times a week over a training program.
- This minor time commitment allows a player more time on the court to develop necessary technical and strategic skills and match competition.
- The circuit program also allows time for other methods of conditioning (e.g., cardiovascular, plyometric/agility, etc.).
- Further benefits of this type of training are that circuits can be modified to fit the needs of any team or individual player and can be carried out at a relatively low expense.
- To make a resistance program even more effective, you must know the specific areas of muscle strength needed for a particular sport.
- For tennis, muscles such as the quadriceps, hamstrings and other rear-leg muscles, abdominals, pectorals, biceps, and forearm muscles should be included in any strength training program.
**INTRODUCTION**

- Tennis players frequently practice the strokes of the game for countless hours over the course of many years to achieve a high level of skill. Ericsson estimated that it takes 10 years or 10,000 hours of training at a high performance level to attain the skills of an elite level player (Ericsson 1993).

- The role of the upper extremities in producing tennis strokes leads to repetitive overuse and high levels of mechanical and physiological stress that often result in injury. Previous research has found that 37% of the top eighty-four professional players had major elbow problems and 31% of 2633 recreational players experienced elbow pain at some point in their playing careers (Priet, 1974, 1980).

- Additional research of the top eighty-four professional players also discovered significant differences in the dominant tennis playing arm grip strength, bone hypertrophy and arm girth, a phenonemon also observed in baseball players and javelin throwers (Gore 1980).

- The prevalence of upper extremity injuries experienced by tennis players highlights the significance of obtaining a total arm strength profile with details on the relationship between the dominant and non-dominant arms. This profile will be instrumental in the preparation of rehabilitation plans for injured tennis players by physical therapists and athletic trainers.

**PURPOSE / METHODS**

- The goals of this study were to obtain a detailed isokinetic strength profile of both the dominant and non-dominant upper extremities in highly skilled male tennis players. A total arm strength base was provided by isokinetically testing the wrist, forearm, and shoulder. In addition, the correlation between isokinetic strength and the speed of the serve were statistically analyzed. Several hypotheses were expected based on prior research in this field. The researchers anticipated that the strength scores of the dominant arm would be greater than the non-dominant arm and that a relationship for each joint and opposing muscle groups would be present. Furthermore, correlations of serve performance and isokinetic strength data for internal rotation were expected based on biomechanical studies of the serve in tennis.

- The participants of this study were 22 highly skilled male tennis players (NTRP 5.0-7.0) from the Phoenix Arizona area between the ages of 20 and 40 that were actively playing in tournaments (7.9± 5.7 tournaments in the last year) or teaching and playing tennis 25.4±16 hours per week on court. All subjects have mastered the fundamentals of the game of tennis through intensive training with an average playing experience of 16.9 ±5.9 years and were free from significant musculoskeletal injury of the upper extremities in the past year. The dominant arm grip strength of all participants was significantly greater (p<.001) than the non-dominant arm.

- A Cybex II dynameter and all of its standard upper body attachments (except for a short input adapter to test wrist flexion/extension developed by the researcher) were used to conduct the isokinetic testing. A Compaq personal computer running Discipline II software and the integrated Cybex dual channel recorder and Real Time Display were used to measure peak torque independent of the range of motion where it occurred. Peak torque (explosive ability) and single repetition work (sustainable force through range of motion) values were examined in this study. In this experiment four motions were tested randomly on the Cybex II: internal and external rotation with the shoulder at 90 degrees of abduction, shoulder flexion and extension, wrist flexion and extension, and forearm pronation and supination. The functional serve test measured the speed of the serve in two methods: a hand held radar gun (Speed Gun One) and video data analysis (Peak Performance Technologies).

**WHAT DID THE STUDY FIND / COACHING IMPLICATIONS**

- All 22 of the highly skilled male tennis players had significantly greater isokinetic strength in the dominant upper extremity.

- The motions of internal rotation, shoulder flexion and extension, wrist flexion and extension, and forearm pronation were greater in the dominant arm.

- There were significant differences between dominant and non-dominant extremities in the two shoulder motions but not in the wrist and forearm motions.

- No significant relationship existed between the overall isokinetic strength profile of the players and their ability to serve at a maximum speed as measured by radar and video methods.

- A statistically significant relationship between the two methods of measuring serve speed, radar and video digitizing, was observed however:
  - The ball velocity of the serve as measured by the Speed Gun One radar and Peak Performance Technologies video methods differed significantly with the speeds from Performance Technologies reported speeds approximately 10 miles per hour faster for both peak and average of 5 fastest serves.

- Considering the findings of this study with respect to the differences in strength of internal and external rotation, it is extremely important that the muscles of the external rotators specifically, the infraspinatus and teres minor are targeted for strength training in highly skilled male tennis players to avoid overuse injuries such as rotator cuff tendinitis and impingement.

- The lack of a statistically significant relationship between isokinetic strength and the speed of serve suggest that the service motion is a complex neuromuscular task that is comprised of many factors. Upper extremity strength of internal and external rotation although important in withstanding the stress of the serve are only part of the equation in serve performance.

- Additional research in this area is needed to provide a greater understanding of the relationship between strength, flexibility and biomechanics of the serve to provide a framework for improvement of physical and skill development in tennis.

- The technologies of a radar gun and video digitizing used in this study to measure the speed were statistically reliable but the video method consistently reported scores at an average of 10 miles per hour faster than the radar method.

**REFERENCES / RESOURCES**


INTRODUCTION

- It has been commonly observed that players have the ability to trade off speed for spatial accuracy (e.g., shot placement, racquet-ball contact location) and accuracy for speed in performing various strokes and other tennis related skills.
- However, it has only been recently recognized that by increasing movement speed an individual also tends to increase timing errors. Because most skills require both timing and spatial accuracy, the selection and performance of an appropriate movement speed appears to lead to a compromise between spatial for timing accuracy.
- While past research looking at these various factors have come to different conclusions, they all appear to agree that movement time, movement speeds, and timing accuracy are intertwined.
- Furthermore, the use of the principles related to response time/speeds and accuracy may have important implications for teaching and practicing timing and anticipation skills.

PURPOSE

- The purpose of this study was to understand the relationship between movement time, range of motion and timing accuracy by examining the effects of controlling the speed and/or duration of a forehand stroke in response to balls traveling at various speeds and durations.

SAMPLE

- Participants for this study were 24 right-handed females with an average age of 23 years.
- The women swung a tennis racquet through a range of motion of 60 degrees, 105 degrees, or 150 degrees over three separate sessions.
- Participants were also assigned to one of four experimental groups:
  - The first group swung the racquet at their preferred speed
  - The second group swung at maximal speed
  - The third group swung 20% faster than their minimal speed
  - The fourth group swung 40% faster than their minimum forehand speed.

YEAR PERFORMED 1989

METHOD

- After practicing the stroke at their assigned speeds, the women attempted to execute their strokes so that their racquet head passed through an infrared beam at the moment that a stimulus (series of lights that progressive flashed down a ramp toward the participant) stopped.
- It has been commonly observed that players have the ability to trade off speed for spatial accuracy (e.g., shot placement, racquet-ball contact location) and accuracy for speed in performing various strokes and other tennis related skills.
- However, it has only been recently recognized that by increasing movement speed an individual also tends to increase timing errors. Because most skills require both timing and spatial accuracy, the selection and performance of an appropriate movement speed appears to lead to a compromise between spatial for timing accuracy.
- While past research looking at these various factors have come to different conclusions, they all appear to agree that movement time, movement speeds, and timing accuracy are intertwined.
- Furthermore, the use of the principles related to response time/speeds and accuracy may have important implications for teaching and practicing timing and anticipation skills.

RESULTS

- Overall, the results of the study indicated that timing accuracy of a simulated tennis forehand was maximized by:
  - Responding, or swinging, with a shorter movement time or faster movement speed
  - A better ability to match one’s movement time to the stimulus (e.g., ball) speed.
  - This does not hold true for slower swings.
  - Decreasing the range of motion of one’s swing.

RECOMMENDATIONS

- Overall, the results of this study support the idea that faster and shorter strokes result in a greater capacity to accurately time one’s swing with a moving target (e.g., an opponent’s serve or other drive across the court).
- These findings suggest the following may be true:
  - Players producing shorter movement times are better able to control and replicate the timing of swings that lead to better anticipation.
  - Shorter movement times allow players to wait on the stimulus (e.g., ball), allowing it to travel further, which provides the player with more information about the stimulus’ speed, trajectory, etc. before a response must be executed.
  - Shorter times to complete a movement or task are easier to estimate and replicate, which would lead to more successful executions of the skill.
- It is also important to understand that there was little difference in the timing accuracy between the participants who performed at their maximal speed and those who performed at their preferred speed.
- It is tempting to believe that players will perform their best when left to decide for themselves what speeds to execute given tennis strokes.
- However, it must also be known that while players who selected their preferred speeds were able to develop an optimal movement time/speed for the forehand drive, but they did so less consistently than those who performed at their maximum speed for all trials.
- Because this study was held in a laboratory setting (as opposed to a tennis court) with a simulated tennis scenario these results must be considered and applied with some caution.
- More research conducted with tennis players in their natural settings is needed to be able to make more accurate and legitimate recommendations for coaching practices.

REFERENCES/RESOURCES


INTRODUCTION

• The physiological demands of a tennis match are not well understood because little research has been conducted on this topic.
• Although some studies have investigated pre- and post-match metabolic responses, there has been little documentation of measurements other than heart rate during actual play.
• Tennis matches are unique in nature as they include intermittent exercise of varying intensity with numerous recovery periods over a long duration, which make duplication of the demands difficult to recreate in a laboratory setting.
• Therefore, field testing through on-court match play is necessary to develop scientifically-based training programs to improve consistency of training methods for tennis.

PURPOSE

• The goals of this study were to measure the following variables of skilled tennis players during near match play conditions:
  - Heart rate
  - Hemocrit
  - Hemoglobin
  - Plasma concentrations of:
    - Glucose
    - Lactate
    - Cortisol
    - Testosterone

• The addition of testosterone measurements allowed for speculation of the overall anabolic/catabolic state during play.
• The testing scheme was designed to offer a “real-time” window of the physiological response to playing a competitive singles match.

SAMPLE

The participants for this study included 10 healthy Division University males of approximately equal playing ability.
• Mean Age: (20.3 years)
• Mean Height: (176.9cm)
• Mean Weight: (72.8kg)
• Mean Percent Body Fat: (10.6%)
• Mean Aerobic Power (VO2max): (58.5ml.kg-1.min-1)
• Players refrained from eating for two hours prior to each test and ingested only water during testing.
• The primary year-round conditioning activity for all the players was tennis in addition to resistance training and moderate running

METHOD

• All subjects completed a laboratory treadmill test as well as an on-court test on separate days.
• Heart rate was monitored by portable monitor during both sessions and blood samples were taken at consistent intervals for measurement of physiological variables.
• The treadmill test was used to determine VO2max, max heart rate, plasma substrate and hormonal responses.
• The on-court tests were conducted on an indoor hard court with a temperature of 17°C and consisted of a 10 minute warm-up period followed by 85 minutes (6, 15 minute periods) of continuous singles play. Recovery time between points was limited to 30 seconds and changeovers were limited to 90 seconds, except when a blood sample was taken. Those changeovers were 135 seconds long.
• Players were asked to maintain the same effort and intensity as they would in a tournament match and to use an all-court style of play.

RESULTS

Results of the Treadmill Test
• VO2max and MHR were 58.5 ± 9.4 ml·kg-1·min-1 and 195.6 ± 6.3 beats per minute, respectively
• Plasma lactate, glucose, and testosterone increased significantly (p<0.05) above pre-exercise concentrations immediately and 5 minutes after exercise.
• Plasma cortisol concentration and ratio of testosterone to cortisol did not change in response to maximal exercise.
• The heart rate increased during the warm-up period (p<0.05) from a pre-exercise value of 75.6 ± 7.7 beats·min-1 to 126.2 ± 7.7 beats·min-1.
• During the 85 minutes of match play, the mean HR was 144.6 ± 13.2 beats·min-1 and remained significantly elevated at 5 minutes into recovery.
• The percentage of MHR (maximal heart rate reserve determined with Karvonen formula) averaged during the warm-up and play was 47.5% and 61.4% respectively.
• Measures of plasma lactate and glucose concentrations did not change (p>0.05) over the duration of the warm-up period and after compared to pre-exercise measures. An insignificant decrease in plasma glucose that was observed after the warm-up period was followed by a 23% increase (p< 0.05) above the warm-up concentration, after the second 15 minute segment of play. The plasma glucose concentration remained steady just above the pre-exercise value from then on.
• A slight (p< 0.05) increase in plasma cortisol corresponded with the decrease in glucose following the warm-up period and plasma cortisol levels progressively decreased during matchplay. The measures obtained at the conclusion of play and into the recovery were significantly lower than pre-exercise concentrations.
• Plasma testosterone levels increased progressively throughout the warm-up and match play session including a significant increase during the 5 minute recovery period.
• In addition, the testosterone to cortisol ratio also progressively increased to significantly greater than pre-exercise values by the end of matchplay and through recovery.
• Plasma volumes changed by the following measures: -0.7± 5.3% post-warm-up, 2.3 ± 4.1% at the completion of play and 5.1 ± 8.3 after the 5 minute recovery period.

RECOMMENDATIONS

• The mean heart rate during the 85 minutes of play was adequate to satisfy the MHR intensity demands for sustaining and increasing cardiorrespiratory fitness in healthy adults even when considering intermittent characteristics of tennis.
• Although the blood glucose concentrations remained relatively consistent, the downward trend in this study as well as in past research strongly supports the ingestion of suitable carbohydrates during prolonged play to sustain glucose levels.
• This study found non significant increases in plasma lactate due to the moderate and intermittent demands of tennis and the relatively high level of endurance of the test subjects. This result points out the importance of endurance training for tennis players and how it is vital in assisting them to reduce lactate levels during play.
• Actual competition may result in higher levels of cortisol because psychological factors can increase plasma cortisol independently of that induced by exercise.
• Although tennis matchplay is composed of intervals of high-intensity exercise, the overall response is similar to that of prolonged moderate exercise.

CONCLUSION

• The demands of singles tennis matchplay was not intense enough to cause an increase in plasma cortisol but did cause an increase in plasma testosterone.
• Based on the plasma lactate response in this study, conditioning programs for tennis should focus on exercises near, but not beyond, the anaerobic threshold.

YEAR PERFORMED 1990
INTRODUCTION-RATIONALE

• For players to withstand the rigorous training routines and the other physical demands of competitive tennis and to be able to perform to their potential they must maintain a healthful and well-rounded diet.

• This study was intended to provide tennis coaches and players with essential information for adopting healthy eating habits and for the enhancement of performance on the court.

PURPOSE

The purpose of this study was to examine the effects of dietary counseling on the nutritional lifestyle habits of elite female tennis players.

METHOD

• To determine the usefulness of the dietary counseling program, players’ diets were logged and analyzed before and after a regular spring tennis season.

• More specifically, the relative amounts of fat, carbohydrate, protein, vitamins, minerals and total calories of each player’s daily intake were measured. Participants’ blood lipid profiles (e.g., blood cholesterol levels), body composition, attitudes toward eating, and self esteem were also assessed pre- and post-season.

• Over the course of the season program sessions were carried out with each individual athlete in both written form and over-the-phone.

RESULTS (cont)

• Overall, results indicated that recommendations made during dietary counseling sessions were incorporated into the lifestyle of those individuals who were interested in and engaged with the program.

• A major recommendation that was consistent for nearly all the players was to increase total daily caloric intake.

• It was also suggested this increase in calories come primarily from food rich in carbohydrates.

• On average, players responded to these recommendations by increasing their caloric intake by 100 calories through an increased consumption of carbohydrates and, unfortunately, grams of fat.

• After the dietary counseling, the players were still below the American Heart Association’s recommended value for percentage carbohydrate intake and above the 30% recommended fat intake.

• The players’ average value for cholesterol intake was well below the American Heart Association recommendation of 200mg per day.

• Other deficiencies in the athletes’ diets were in their daily intake of vitamins A and C, pantothenic acid, calcium, and iron.

• Although calcium intake had increased by the post-season assessment, it was still well below the recommended daily allowance.

• While total cholesterol and ‘good’ cholesterol (i.e., HDL-C) did not change over the course of the study, players’ ‘bad’ cholesterol (i.e., LDL-C) decreased, on average, by 24 mg%.

• Interestingly, although the younger university players consumed more total calories and fat calories compared to the ‘A’ team players, they had the lowest total cholesterol and LDL-C levels.

• Five players maintained a relatively stable body composition throughout the period of the study.

• One player had a significant weight loss (about 13 lbs.), with primary weight loss in fat and a maintenance of lean body tissue.

• A second player increased her total body weight, mostly due to increased lean muscle mass. This increase was thought to be due to an increased caloric intake as well as the university team’s weight training program.

• The psychological assessments showed that all participants had either average or the highest self esteem scores as well as Eating Attitude Test scores that indicated no symptoms of eating disorders (i.e., anorexia nervosa).

YEAR PERFORMED 1990

RECOMMENDATIONS

• On average, the players who participated in this study fell short of meeting many of the American Heart Association’s dietary guidelines (e.g., low overall caloric intake, low carbohydrate caloric intake, high fat caloric intake, low dietary cholesterol intake and insufficient intake of vitamins A and C, pantothenic acid, calcium, and iron).

• These findings provide evidence for nutritional deficiencies that are common to this class of athletes as well as justification for the implementation of dietary counseling programs with similar groups.

• A dietary counseling program could serve as a useful tool for optimizing players’ on-the-court performances and overall well-being at all levels of play.

• These benefits should result from program outcome factors such as healthier body composition and blood cholesterol profile.

• Other benefits may include better immune functioning and increased energy necessary for heightened functioning on the court.

CONCLUSION

• This study indicated that for a nutritional intervention to be most effective, a player must be bought into the process and interested in offering full participation.

• Be aware that there are related health conditions that cannot be altered by dietary changes alone (e.g., excessively high cholesterol levels). Conditions such as these warrant further monitoring and a medication intervention.
Effects of Biomechanical Feedback on the Tennis Serve

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This research was funded by a USTA Sports Science and Medicine Research Grant (1991).

INTRODUCTION-RATIONALE

- The tennis serve is a complex skill in which the performer attempts to coordinate the greatest controllable racquet speed at the time of impact with the ball. The skilled athlete learns to generate this swing with the effortless and rapid rhythm of knee bend, body and shoulder rotation, elbow flexion and extension, and downward rotation of the forearm.

- Feedback of the movements that make up a player’s serve provides essential information for the learning and performance of the skill. Additionally, the accuracy and timeliness of the feedback will influence the individual’s speed of skill acquisition.

- Customarily, tennis players rely on their coaches visual assessment (which may be inaccurate), the results of the serve (which is delayed), or self-perception of one’s body position and movement (which may be inaccurate and is certainly delayed) to perfect their service motion.

- Consequently, the serve remains the most difficult tennis shot to learn, due in some part to the imprecise and delayed nature of the available movement feedback. This study looked to examine the usefulness of a biomechanical device in providing more accurate and immediate feedback to tennis players.

PURPOSE

The purpose of this study was to test if auditory feedback of players’ service technique from a device known as the “Whistler” would help improve the performance of the tennis serve (i.e., service speed and accuracy).

SAMPLE

Participants for this study were eight recreational tennis players with an age range of 26 to 76 years and National Tennis Ratings between 2.5 and 5.5.

YEAR PERFORMED 1991

METHOD

- The “Whistler” (84 ounces) was placed on the midpoint of the players’ racquet throats, and made a whistling sound at the moment of the athletes’ peak racquet speed during the performance of a serve.

- Participants performed a series of four trial sessions with the goal of moving the whistle higher (which would signify a faster service swing) and closer to the maximum contact height of the swing (which was assumed to be an essential quality of a “good” serve). Video recordings were also taken to assess the accuracy of the players’ serves.

- Participants reported their service effectiveness showed marked improvement because of the feedback provided to them from the Whistler.

- All players’ achieved greater ball speed as a result of the Whistler intervention.

- However, because this improved speed was often accompanied by decreased accuracy, the analyses of the players’ overall performance did not improve. More specifically, 46 serves were hit successfully before feedback was provided by the device and only 47 serves were performed successfully after the feedback.

- Interestingly, the players with lower ability ratings showed more improvement in serve speed and accuracy than the higher ranked athletes. This finding may be due to the better ranked players being more resistant to technique change and more strongly attached to their former techniques.

RESULTS

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CONCLUSION

- The Whistler is a device that provides players with positive feedback because it only sounds when players were able to reach significant speeds.

- This type of reinforcement can create a rewarding and fun learning experience because it focuses on improvement and correct technique as opposed to drawing one’s attention to performance errors.
Fluid-Electrolyte Balance Associated With Tennis Match Play in a Hot Environment

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This research was funded by a USTA Sports Science and Medicine Research Grant (1993).

INTRODUCTION

• On court observations and past research has shown us that many amateur and professional tennis players are not able to perform optimally under hot and/or humid conditions due to a number of factors including heat illness, heat stroke, impaired endurance capacity, and changes in players’ fluid-electrolyte balance.
• Water (or fluid) is not only essential for tasks such as proper organ functioning and functioning of the senses, but is also responsible for regulating one’s body temperature.
• Electrolytes (e.g., sodium, calcium, and potassium) also play a vital role in keeping the active body running smoothly by facilitating proper muscle and nerve functioning and aiding in fluid-balance maintenance.
• Studies that have investigated fluid-electrolyte balance in tennis have done so under limited conditions, only observing changes in the fluid-electrolyte concentrations at moderately high temperatures (73-81 °F; 23-27 °C) during one competitive or simulated match.
• This study set out to mimic a more extreme playing environment (in terms of temperature) over a longer period of time (similar to standard tournament play).

PURPOSE

To determine:
• If significant body water and electrolyte losses would occur during play in a hot environment
• If hydration and plasma sodium deficits would occur without changes to players’ diet.

METHOD

• For 3 days (temperatures ranging from 81 to 93 °F), the players participated in a simulated round robin tournament, with 2 singles and 1 doubles match per day.
• After the last match of each day, the athletes’ off-court food (sodium and potassium were assessed) and fluid intake was recorded and collected.
• To test for fluid and electrolyte level changes, the players had blood and urine samples collected, the sweat on their tennis attire was monitored, their changes in body weight were calculated, and they completed a perceived thirst survey after their last match of each day.

RESULTS

Midday Singles Matches
The following observations were made during the singles matches over the course of the 72 hour observation period:
• Male players had a greater average sweat rate than female players and had more variation in the sweat-rates between players.
• Thirst is probably not a timely or sufficient gauge of a player’s level of dehydration because the reported thirst levels of the athletes did not match their actual fluid loss.
• The quantities of fluid lost in this sample were relatively small. This may have been due to the fact that the players were aware that their fluid intake was being monitored and because water was readily available at the simulated matches.
• It appeared that the electrolytes (sodium and potassium) lost during competition were compensated for by the natural diet of the players.

RESULTS (cont.)

Daily Changes
Fluids
Body water measurements observed from blood tests generally reflected little or no change in hydration status.
• Plasma body water changes from pre- to post-play varied greatly among the individual athletes.
• Changes in hydration status ranged from a slight increase (which may reflect a more hydrated state) to little or to no change in plasma volume.
• The minor or nonexistent changes in plasma volume could be due to the natural tendency of the fluids within the body’s cells to move outward into the plasma because of the physical demands placed on the players.
• Body water status observed from urine tests indicated slight decreases in hydration from pre- to post-play each day.
• Players were not well hydrated at the start of each day of competition and the fluid the athletes drank during matches did not fully compensate for the sweat lost throughout the day.
• Also, players did not appear to be replacing lost fluid from the previous day’s activities during their off-time.

Electrolytes
In general, the players maintained an electrolyte balance throughout the study period.
• Even though sodium levels remained normal throughout the study period, the lowest level of plasma sodium was observed on the 4th day.
• This decrease was most likely due to the multi-day competition demands for which the body could no longer fully replace the sodium loss with normal daily food intake.
• Potassium levels were also maintained within a normal range throughout the study period.

SAMPLE

20 participants (12 males, 8 females) from 2 Division I Universities participated in this study:
• Mean Age: males (20.5 years), females (20.3 years)
• Mean Height: males (180.0 cm), females (166.8 cm)
• Mean Weight: males (73.8 kg), females (60.3 kg)
• The players who participated in this study were selected because they fit the criteria needed for fitness and acclimatization to the playing environment.

RECOMMENDATIONS

• Fluid replacement and maintenance should be primary concerns for your players regardless of the climate conditions of the competition environment. Practicing and competing in hot and humid environments makes these practices even more essential.

Fluid Intake Recommendations
• Past recommendations are most likely insufficient (only capable of replacing about 50% of fluid lost) for play in hot conditions in which players lose a significant amount of body water through sweat.
• However, if a player attempts to replace all of the fluid lost during a match, he or she may experience stomach discomfort during competition.
• Most athletes’ bodies will not be able to absorb more than 10 ounces every 10 minutes (or 10 mouthfuls of fluid every 10 minutes).
• Remember, every player is an individual. Some may be able to consume more fluid during a competition than others without experiencing any discomfort.
• Be sure to have your athletes make a habit of regularly consuming either cold water or carbohydrate-electrolyte based drinks during practice to help them become more acclimated to drinking while being active.

Fluid Type Recommendations
• To increase the likelihood that your players are consuming the essential quantities of fluid, have cold and sweet beverages available. The more tasty the beverage, the more likely the athletes will be prone to drink it.
• Re-hydration using cold water is a useful strategy for regulating body temperature, however, carbohydrate and electrolyte based drinks may be just as effective with the additional advantage of providing athletes with energy for competition.

Electrolyte Recommendations
• Electrolyte supplementation during competition is only recommended if the player is experiencing a deficit or is playing for an extended bout of time (e.g., several rounds of a tournament in one day).
• You may want to have your players increase sodium in their regular diets after two to three days of tennis play in hot or humid conditions if they plan on continuing play for another day.
• If dietary changes are not made to replace lost sodium due to use and sweat, players may develop on-court problems such as heat-related muscle cramps.

CONCLUSION

The authors concluded that “this select group of well-trained and heat acclimatized athletes generally maintained overall fluid-electrolyte balance in response to playing multiple tennis matches on three successive days in a hot environment.” Even so, it was suggested that players may still benefit from a carbohydrate based, electrolyte replacement drink (as opposed to plain water) during and after play, especially for matches that are longer than two hours in duration.
INTRODUCTION

- Talent identification information and processes have tended to lack a standardized approach and are nearly nonexistent for tennis researchers and practitioners. As a result, no one has identified the key factors that consistently distinguish elite from non-elite junior tennis players.
- However, there are several different areas of research that point to various features that tend to characterize the most talented young performers.
- These areas include:
  - skill mastery (e.g., the desire to reach high levels of performance, great enjoyment of practice, learning, and participation in tennis),
  - high levels of commitment to the sport,
  - psychological traits (e.g., high performance under stress, focus on cues such as an opponent’s tendencies, strengths and weaknesses, and resistance to distractions such as negative thoughts or anxiety),
  - physical abilities and attributes (e.g., height, weight, power, agility, and flexibility), and
  - environmental factors (e.g., family background, socio-economic status, education, age, ethnicity, and gender).
- This project attempted to produce a comprehensive talent identification method that could take into consideration these factors and illustrate their usefulness for predicting performance in the junior tennis setting of time (similar to standard tournament play).

PURPOSE

The purpose of this study was to determine a protocol that would inform its users of the relative importance of certain factors that are essential for elite tennis performance in young players. A second goal was to discover which of these factors best predicts future performance.

SAMPLE

Participants for this study were 122 (51 male and 71 female) junior players from USTA training camps in Southern California and Southern Florida. At the California, site the mean age for the boys was 12.26 years and 11.95 years for the girls, while the boys at the Florida site were on average 12.25 years and the girls were on average 11.80 years. Thirteen of the boys and 24 of the girls at both sites had been or were currently ranked among the top 10 players in their section.

METHOD

Each participant completed 12 physical tests (e.g., measures of height, weight, and body composition), 4 psychological surveys (e.g., personality and mental toughness inventories), and a background questionnaire (e.g., measures of practice and competitive habits, goals, and perceptions of parental expectations).

RESULTS

- Overall, the assessments selected (i.e., physical characteristics, motor abilities, psychological traits, and background information) for the talent identification process were useful and reliable.
- A few tests proved to be impractical or provided little useful information in terms of talent identification (e.g., dynamic balance and timing tests did not appear to discriminate the less and more successful performers in any meaningful way).

Physical Traits:
- Female players’ height and weight did not appear to distinguish the differently ranked players; however, lower percentage body fat measures were more common among the higher ranked players than their lower ranked peers.
- The top ranked males were nearly identical in height and weight, but there was a trend for the smaller sized players (shorter, lighter, and less body fat) in this group to rank ahead of the larger sized players.

Motor Abilities:
- The primary factors that separated the higher versus lower ranked female players were greater strength, speed, agility, power, and vertical jump.
- It did not appear that increases in most motor abilities distinguished the less from the more able tennis players.
- This finding suggests that perhaps there is some optimal level of these abilities rather than a “more is better” principle being in place (e.g., moderate levels of leg power may be superior to less power that restricts force generation and high power that can hamper agility).
- Exceptions to this finding were that higher level male players tended to have better hand-eye coordination and higher stroke ratings than the lower ranked players.

Psychological Traits:
- Higher ranked male and female players believed that success was mostly due to the effort and ability of an individual athlete.
- The Mental Toughness Inventory was more useful for distinguishing between the high and low ranked female players in the older age group.
- Among these players, those who were ranked higher reported higher levels of confidence, focus, and energy control.
- Higher ranked male players tended to score higher on measures of motivation, energy control, and focus.
- Extroversion is another quality that was found to be common among all of the high level athletes who were tested.

RECOMMENDATIONS

- Random selection of inventories or test of talent is inappropriate. The assessment(s) used must be reliable, practical, and relevant to the sport of tennis and its participants.
- The project findings provide a method to predict current top-15 players in a particular section. However, these results cannot and should not be used to predict player rankings several years into the future.
- Certain factors for the various age and gender groups appeared to be important predictors of higher versus lower ranked players with the groups that were studied:
  - Girls; 11-12 years:
    - Higher levels of extroversion, agility, relative sitting height, body weight predicted higher ranked players.
  - Girls; 13-14 years:
    - Higher levels of ego orientation (compete to succeed above others), task orientation (compete to achieve high level of skill), ratio of task to ego orientation (with greater focus on task versus ego oriented goals), and faster anticipation timing predicted higher ranked players in this group.
  - Boys; 11-12 years:
    - Better dynamic balance (leaping in various directions and balancing on one leg), power, ability level of opponents, flexibility and focus predicted higher ranked players in this group.
  - Boys; 13-14 years:
    - Greater height, belief that ability determines success in tennis, number of hours each week completing homework, opponent ability, and lower skinfold thickness predicted higher ranked players in this group.
- Information gathered from this study should be considered with caution because of the small number of players who were studied. More research is needed in this area before these predictions can be made with more certainty.

REFERENCES/RESOURCES


INTRODUCTION

• Changes in range of motion (ROM) in one’s joints and muscle flexibility are thought to significantly affect risk of injury in athletes. This issue is especially relevant for players participating in repetitive-use sports such as tennis.

• Although the exact causes and effects of the relationship between ROM/flexibility and injury are not known, decreased motion at certain joints are generally considered to be maladaptive. In fact, recent research suggests that decreased motion and muscle inflexibility creates movement changes and predisposes players to further and more serious injury at the tissue and cellular levels.

• This project sought to create an injury prevention program designed to address these issues by emphasizing the identification and correction of maladaptive conditions such as deficits in ROM and flexibility so that risk of serious injuries associated with these conditions can be reduced in junior tennis players.

PURPOSE

The purpose of this study was to determine the effectiveness of a conditioning program designed to address range of motion (ROM) in competitive male and female junior tennis players.

SAMPLE

Fifty-one tennis players, 29 males (average age of 13.6 years) and 22 females (average age of 13.2 years), participated in the study.

METHOD

• These players took part in a conditioning program consisting of standard physical therapy flexibility exercises using the stretch, hold, and release technique.

• To ensure proper exercise execution, the exercises were first taught to the participants in person and then later provided through demonstrations on a videotape of the exercise routine.

• Along with changes in players’ ROM, the degree to which players complied with the training program was measured through exercise logs and reports from the players and their parents.

WHAT DID THE STUDY FIND?

• Results indicated improvement in almost all ROM measures after one year of training.

• However, little further improvement was observed in the second year of the program.

• It was determined that these positive changes in ROM were related to the conditioning program as opposed to other factors such as age, gender, skill level, and amount of time playing tennis.

• When compared to players who did not participate in the conditioning program, participants showed increases in several ROM measures including (but not limited to) the sit and reach test, inward shoulder rotation of the dominant and non-dominant arms, gastrocnemius (the action which extends the foot and bends the knee) of the non-dominant leg, and outward hip rotation of the dominant and non-dominant legs.

• Except for forearm supination (rotation inward, toward the body), there were no differences in ROM changes between high complying versus low complying players.

• The areas that showed the greatest improvement with training were in the shoulder and back, which are areas at most risk for injury in tennis players.

• In conclusion, joint ROM can be positively influenced with a specific conditioning program.

COACHING IMPLICATIONS

• The study confirmed that range of motion (ROM) deficits can be found in tennis players at young ages and consistently across athletes.

• Also, without intervention, these conditions can become worse with time and continued participation.

• This study also demonstrated that ROM and flexibility can be enhanced with a specific conditioning program based on a sport specific evaluation of the sport and an evaluation of each individual player.

• It appears that the conditioning program has its greatest effects during the first year of implementation. After that point, the prior improvement can be maintained (with further participation in the program) in the face of continued play.

• Recommendations are that players perform the flexibility exercises 4 to 5 times per week to correct inflexibilities.

• Thereafter, the exercises should be continued on a maintenance level 2 to 3 times per week.

• The following are examples of the program exercises:
  - Toe-touch (standing or seated)
  - Cross body stretch
  - Shoulder external rotation
  - Shoulder internal rotation
  - Pretzel stretch

• It is especially important that athletes who play tennis intensely, and who are at greater risk for developing maladaptions in ROM and flexibility, are encouraged to include these exercises in their training program. This is true for players with or without clinical symptoms of related injuries.

• To improve adherence to the conditioning program, the frequency of the exercises should be reasonable, the exercises should be safe, and the exercises should be easy to learn and to perform.

REFERENCES / RESOURCES


INTRODUCTION

Forehand Drives:
- Changes in tennis racquets, including increased stiffness and decreased racquet weight, have influenced various techniques used in play. The increased power of groundstrokes and serves, partially due to these equipment modifications, has fueled the trend of athletes adopting more open stance (than square stance) forehands. Unfortunately, the open stance forehand may not utilize the optimal series of body movements to produce the most effective and safest tennis technique, which may lead to overstretch on players’ upper bodies.

- Although there is a great deal of controversy regarding which stance is better, very little scientific information is available which would answer this question. Therefore, this study aimed to investigate differences between the two stances with a focus on the upper extremity components of the two techniques.

PURPOSE

- The purpose of this project was to look at the differences in the open and square stance forehand swings and differences in performances of these techniques from players of different skill levels.
- Participants for this study were 15 tennis players, with approximately half of the players qualifying as professionals (8 male certified teaching pros) and the other half being intermediate players (2 males and 6 females with NTPR scores ranging from 3.5 to 4.5). The participants were analyzed performing the open and square stance forehand drives using high speed film and computer technology.

RESULTS

- The square stance generated faster racquet speed than the open stance.
  - This result was observed in both groups with a difference of 4% for the pros and 9% for the intermediate players resulting between the two techniques.

- The racquet speeds of the intermediate players were 20% and 23% lower than the professionals in the open and square stance, respectively.

- The paths of the racquet through the swings was similar for both groups of players as far as racquet height was concerned, but there were differences between the groups in the way their racquets moved horizontally.
  - More specifically, the pros’ upper arm was more forward in relation to their trunk at ball contact than the intermediate players.

- The professionals had a more accurate racquet path in the square stance than the open stance, with the reverse being true for the intermediates.

- For the pros, the open stance created a 60% reduction in time that the ball could be successfully contacted on the racquet.

- All players were able to produce greater trunk rotation in the square stance than the open stance, with professionals generating more trunk rotation than the intermediates with both techniques.

- The same major groups of muscles were used to perform both forehand techniques.

- However, the square stance generated larger muscle action than the open stance.

COACHING IMPLICATIONS

- The results of the study support the idea that the square stance is superior to the open stance in terms of generating more power.

- Although the footwork is different across stances, the motions and muscular actions of the upper body are very similar during the two forward swings.

- The footwork in the open stance provides little transfer of momentum in the forward direction and possibly a lesser amount of angular momentum.

- This will reduce the player’s ability to produce greater trunk and shoulder rotation, resulting in the development of less muscle activity and slower joint and racquet speeds.

- In contrast, the square stance allows players to transfer the momentum generated during the weight shift and possible generate more angular momentum.

- The greater angular momentum would result in greater muscular contractions and faster joint and racquet speeds.

- Another observed benefit of the square stance is that it provides players with more time to move their racquets into the appropriate striking position than the open stance.

- While the square stance appears to be superior to the open stance, one must keep in mind that these results may be more applicable to players of higher ability (e.g., intermediate players were able to perform more accurate racquet paths through their forehand swings using the open stance).

- Choose the technique that is more appropriate to your individual players.

REFERENCES / RESOURCES


INTRODUCTION

Among all of the tennis strokes, the stroke characteristics of the volley are rarely investigated. This is surprising considering the stroke’s importance as an offensive weapon in both singles and doubles play.

Although descriptions of the tennis volley are useful for teaching and instruction, currently, there is little information about the process of transferring weight and propelling the body for the volley or detailed descriptions of the movements that comprise strokes.

Furthermore, the common pattern or principles used for volleying at various ball speeds, locations, and heights have never been investigated. The present study sought to fill this gap in the research and the information available to coaches and other practitioners in the tennis world.

PURPOSE / METHODS

The purpose of this study was to describe selected reaction and movement characteristics of the tennis volley.

Seven skilled male tennis players (National Tennis Ratings of 5.5 or greater) with an average age of 24.7 years (ranging from 17.6 to 31.8 years) served as participants for this study. Four players were currently NCAA Division I players, while the other three had previously competed on Division I teams in previous years.

These athletes were asked to perform volley strokes under 18 different conditions that varied across the lateral ball contact location (forehand (FH) and backhand (BH)), ball contact height (high, middle, and low), and ball speed (high, medium, and low). To initiate the volleys with the players, a ball machine was used which had been modified so that the players could not predict the ball trajectory before it was released from the machine. Each participant was assessed on his muscle activity, ground reaction force (GRF), and reaction time while performing the various volleys.

WHAT DID THE STUDY FIND / COACHING IMPLICATIONS

According to the players, they could handle the volleys on both sides (FH and BH) with the same degree of success as long as the oncoming balls were ‘within reach.’

When they needed to reach out to execute a volley, the players performed better on the FH side.

The average reaction time (from ball release to the instant a player’s racquet began to move) for the different stroke conditions ranged from 205 to 226 milliseconds.

The stroke times (from initial racquet movement to ball impact) demonstrate that skilled tennis players could complete a volley successfully in under 0.4 seconds.

Participants rarely had enough time to start the crossover step before making contact with the ball unless the ball speed was slow.

Even when the ball speed was slow, however, players timed their crossover so that the step was not completed until after they had made contact with the ball. This resulted in a forward motion that continued through the stroke.

Punching actions (a forward racquet motion immediately before ball contact) occurred on 75% of the observed FH and BH trials.

Additionally, this action occurred most often in the low speed and middle height conditions.

A sidestep of the foot on the side of the oncoming ball (before the crossover step of the other foot) occurred more often in the FH (45% of the trials) than in the BH (34% of the trials).

WHAT DID THE STUDY FIND / COACHING IMPLICATIONS

Players shifted their body weight toward the foot on the side of the oncoming ball before moving their racquet.

During the pushing phase of the volley: The players’ forward and sideward movements were the result of a push off with the foot on the opposite side to which the ball was traveling;

Sideward movements were initiated by a sideward lean during low speed volleys and a vigorous push off from the foot opposite of the side to which the ball is traveling on the high speed volleys;

Players significantly lower their center of gravity in the low volleys;

The height gain needed for a high volley was accomplished by a strong push off with the foot on the side to which the ball is traveling.

There was more wrist extension than flexion during the volleys because of the players’ need to hold up the racquet head. In addition, players tightened the grasp on their racquets shortly before and through the point of ball contact.

The greatest muscle activity in the players’ triceps occurred during the forward swing of the volley.

This result indicated that elbow extension is one of the principal components of the punching action.

It was observed that the deltoid (antero-middle and postero- middle) muscles were used to stabilize the shoulder joint during the volley.

The role of the pectoral muscles during the forward swing phase of the forehead volley was to move the arm and racquet forward during the punching action.

However, in the low forehead volley, the responsibility of this movement was also shared with the deltoid (antero-middle) muscle.

Players’ upper bodies were more upright (with less forward lean) during the backswing phase of the low volley.

REFERENCES / RESOURCES


The One-Handed Backhand and Tennis Elbow

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This research was funded by the USTA Sport Science and Medicine Research Grant (1997)

INTRODUCTION

- Research has often documented a link between the one-handed backhand and tennis elbow (i.e., tendonitis of the elbow). A recent review of tennis elbow research concluded that it is the rapid stretch of the forearm extensors (muscles in the upper arm that extend the forearm) after impact in the backhand that may be the mechanism of injury for this condition.
- We also now know that less skilled tennis players may be at even greater risk for developing tennis elbow because of their tendency to stroke backhand drives with the wrist in a more flexed position than skilled players. Becoming aware of the biomechanical factors that may be related to tennis elbow is critical to understanding and developing possible preventive measures for this injury.
- Therefore, a study is needed to examine the relationship between the shock produced during ball-racquet impact and the motions of the wrist and elbow that rapidly stretch the wrist extensors during tennis strokes such as the one-handed backhand.

WHAT DID THE STUDY FIND

- There were no significant differences in the basic movements of the backhand stroke between the three groups (PRO, - TE, and + TE) before ball/racquet impact.
- All the players performed the stroke correctly with the elbow in almost full extension throughout the stroke.
- There were also no differences observed in racquet impulse after impact or the angular position or movement speed of the elbow between the three groups of players.
- There was a significant difference between wrist motion speed after ball/racquet impact between the PRO and + TE groups.
- While the PRO group extended their wrist after impact (-4.4 radians/second), the + TE group flexed their wrists more slowly (0.42 radians/second) at this point in the stroke.

GOALS OF THE STUDY

- The purpose of this study was to measure the shock during and the resulting wrist and elbow joint motion after impact in the tennis one-handed backhand for advanced and intermediate players with and without a history of tennis elbow.

SAMPLE

- Participants for this study were 16 male tennis players with an average age of 35 years. These were all right handed and naturally used the one-handed backhand. Players were grouped into one of the following categories:
  - tennis professionals with no history of tennis elbow (PRO);
  - intermediates with no history of tennis elbow (- TE);
  - intermediates with a medically confirmed history of tennis elbow who now show no symptoms (+ TE).

METHOD

- After a warm-up and practice period, participants performed at least 30 flat one-handed backhand strokes down the center of a mock-tennis court with a machine-projected ball at typical rally speeds.
- Data was collected on muscle activation at the wrist and elbow and the motion path of the racquet during the backhand stroke.

YEAR PERFORMED 1997

WHAT DID THE STUDY FIND / COACHING IMPLICATIONS

- This research and past studies have shown that increased stress on the muscles from repeated eccentric muscle actions of the wrist extensors may be an important influence in tennis elbow development.
- A major difference between the professional level players and intermediate level athletes who had once suffered from tennis elbow appeared to be a tendency for the pros to extend their wrist after ball/racquet impact, while the intermediates flexed their wrist after the moment of impact.
- Therefore, encouraging the wrist extension technique in your players may help reduce the likelihood that they will develop tennis elbow from the repeated use of the backhand stroke.
- Wrist strengthening exercises might help players adopt the post-impact extension of the wrist.
- A common novice technique error that has been found to lead to tennis elbow is a leading of the elbow through the backhand swing.
- Correcting this maladaptive technique in your players could also reduce the likelihood they will develop tennis elbow.

REFERENCES / RESOURCES


An Isokinetic Profile Of Trunk Rotation Strength In Elite Tennis Players

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ABSTRACT

The changes in stroke production in the modern game of tennis have increased the demands in trunk rotation in the elite tennis players. However, no study to date has objectively quantified side to side rotational trunk strength in these players.

Ninety-four elite tennis players were tested using a Cybex isokinetic torque rotation unit at a 60 and 120 degrees per second to measure left and right rotational strength. A subset of 28 subjects performed a functional series of medicine ball tosses using forehand and backhand movement patterns with a 6 pound ball.

A repeated measures ANOVA was used to determine side to side rotational differences and a Pearson correlation was used to test the relationship between the functional medicine ball toss and the isolated isokinetic trunk rotation test results.

No significant differences in forehand and backhand trunk rotational strength was found in the elite male tennis players. In females, slightly greater backhand rotation strength was found at both testing speeds. Significant correlations were also found between the functional medicine ball toss and both forehand and backhand isokinetic strength variables.

These findings suggest that conditioning programs for elite tennis players should include exercises to develop bilateral trunk rotation to provide vital core stability to the spine and torso to meet the rotational demands encountered during tennis play.

INTRODUCTION

Musculoskeletal demands placed upon the human body during tennis play have resulted in a characteristic pattern of upper extremity injuries in tennis players. Injuries to the lower back can be included in among the characteristic injuries in elite tennis players. Rotation of the trunk during the serve and groundstrokes is an integral part of the development of power and energy transfer of energy up the kinetic chain from the lower extremities (Roetert & Gruppel, Ellenbecker & Davies). The integral role that trunk rotation plays in tennis performance has led to a greater awareness and utilization of conditioning programs to improve core stability to enhance performance and prevent injury. However, little research is available to guide clinicians in the proper design of these stabilization programs nor is there an established method to identify player who are deficient in core strength and may require these programs.

PURPOSE

The purpose of this study was to isokinetically measure bilateral trunk rotation strength in elite tennis players and to determine if differences exist in side-to-side rotational strength. Additionally, the study sought to determine the degree of correlation between isokinetically measured trunk rotation strength and a functional medicine ball toss that uses trunk rotation.

METHODS

• Following a brief warm-up, subjects were placed in the Cybex Torso Rotation isokinetic dynamometer (Cybex Inc, Ronkonkoma NY) in a seated position with 90 degrees of hip and knee flexion (figure 1).

• Five maximal repetitions at 60 degrees per second and 15 maximal repetitions at 120 degrees per second were performed. A 30 second rest period was allowed between sets.

• A subset of 28 subjects threw a six pound medicine ball, using both hands, in a forehand and backhand movement pattern from a stationary starting position (Figure 2).

• Two repeated measures ANOVAs were used (one for males and one for females) with dependent t-tests being used where main effect differences were identified. A Pearson correlation coefficient was used to determine the relationship between the isokinetic strength and functional medicine ball performance.

RESULTS

• No Significant strength differences were found in the male subjects between forehand and backhand rotational strength.

• Females demonstrated a significant (p<.001) side-to-side strength difference. Female subjects had significantly greater (p<.001) backhand rotation peak torque and single repetition work values at both 60 and 120 degrees per second as compared to forehand rotation.

• Significant (p<.001) correlations were found between the peak isokinetic rotational strength and both forehand and backhand functional medicine ball tosses (r=0.80).

IMPLICATIONS AND APPLICATIONS

• Elite level players have very high levels of trunk rotation strength.

• Training methods should promote symmetrical strength development in forehand and backhand rotation.

• Players with side-to-side strength differences of more than 5-10% should perform exercises to balance trunk rotational strength.

• A medicine ball toss can be used as an effective field exercise to estimate trunk rotational strength.

ACKNOWLEDGEMENTS

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YEAR PERFORMED 1998

40.
INTRODUCTION

- In self-paced tasks such as the tennis serve, basketball free throw or golf shot, elite level players often use a "pre-performance routine" to mentally and physically prepare to execute the skill. This routine is suggested to have an impact on performance.

- Pre-performance routines are defined as the behavioral responses combined with the cognitive strategies that aid in relaxation, cognitive restructuring, and decision making prior to performing a task.

- Prior research and theory have explored pre-service routines to aid in physical and mental preparation for the serve however; few studies have examined the connection between consistent pre-service routines and serve accuracy.

PURPOSE

- The purpose of this project was to observe the behaviors, sequence, and timing of the pre-service routines of professional women tennis players during tournament play to determine if serve accuracy can be predicted based on the consistency of pre-service routine. This study also looked to investigate the following hypotheses:
  - That the consistency of pre-serve routine was significantly related to first and second serve accuracy.
  - That the pre-serve routine of the first serve was significantly related to that of the second serve.

METHOD

- The subjects were videotaped while playing in the 1997 Hardcourt Tennis Championships. The pre-service routines were observed by investigators that coded the player’s overt behaviors and sequence as well as the time of each routine.

- After coding all routines, the behaviors and sequence which appeared most frequently were considered to be the consistent pre-service routine for that player.

- A forward multiple regression analysis was used for all, first and second serves to determine variance in accuracy attributable to changes in behavior, sequence, and absolute deviation of the routines.

- In self-paced tasks such as the tennis serve, basketball free throw or golf shot, elite level players often use a "pre-performance routine" to mentally and physically prepare to execute the skill. This routine is suggested to have an impact on performance.

- Pre-performance routines are defined as the behavioral responses combined with the cognitive strategies that aid in relaxation, cognitive restructuring, and decision making prior to performing a task.

- Prior research and theory have explored pre-service routines to aid in physical and mental preparation for the serve however; few studies have examined the connection between consistent pre-service routines and serve accuracy.

RESULTS

- The results indicated that the consistency of pre-service routine behaviors, sequence and time were not significantly related to accuracy of all, first and second serves.

- Significant differences in behavior and time were observed between first and second serve pre-service routines. There was no significant difference between the sequence of the first and second serve pre-service routines.

RECOMMENDATIONS

- Although the consistency of a pre-service routine was not a significant predictor of serve accuracy, it is not suggested that the use of a pre-service routine is ineffective.

- It is possible that at the professional level, it may not be necessary for the same exact behaviors, sequence and timing for each pre-service routine and that the presence of any routine is enough to trigger the automatic process used to execute the serve accurately.

- Altering of the pre-service routine behaviors and timing can be the result of differences in strategy and psychological stressors between first and second serves.

- Accuracy of the serve may be more closely related to changes in the environment once the ball is tossed or tennis specific considerations such as the speed accuracy trade off.

REFERENCES/ RESOURCES

Cohn, P.J. (1990) Pre-performance routines in sport: Theoretical support and practical applications. The Sport Psychologist, 4, 301-312


YEAR PERFORMED 1998
INTRODUCTION

- In the early 1900’s, concerns were raised involving the increasing speed of the game.
- This increasing speed is partially due to developments in racquet manufacturing technology that has produced relatively stiff and maneuverable racquets that have contributed to an increase in power for all tennis strokes.
- As a result, the increased pace of the incoming shots has reduced the amount of available preparation time for the tennis player, which has initiated changes in stroke mechanics and strategy among all skill levels of the game.
- Several solutions to the ‘power surge’ in tennis have been proposed including decreasing ball pressure, raising the height of the net, increasing the distance of the serve, and increasing the size of the balls.
- Among the above options, increasing ball size has been suggested as the most practical method to slow down the pace of the game. In addition to slowing play, the larger ball is thought to decrease reaction time due to its better visibility in comparison with standard sized balls.
- However, an oversized tennis ball may affect other dimensions of the game such as the racquet acceleration, muscular activity, and reaction time of the player.
- This study attempted to give more insight into the differences in initial shock conditions of the racquet between the standard and oversized balls during a volley.

SAMPLE

Participants for this project were 29 university students who played tennis recreationally.
- Gender: males (n=20), females (n=9)
- Age Range: 19 to 43 years (ave. of 23.6 years)
- Average Height: 5 feet 9 inches (174.3 cm)
- Average Weight: 164 lbs. (74.2 kg)
- USTA Rating (self-rated): 2.5 to 4.5

PROJECT METHOD

Participants were asked to perform volleys under different conditions of ball type (standard vs. oversized), ball speed (44.7, 50.8, and 60.4 mph), and lateral contact location (forehand vs. backhand shots).
- During the volleys, the activity of select arm muscles were measured along with racquet vibrations after ball/racquet impact (acceleration) and the time it took players to initiate movement in response to ball projection (reaction time).

RESULTS

Reaction Time (from ball projection to players’ initial movements):
- There was no significant difference in reaction time among the different ball types.
  o This finding suggests that oversized balls do not improve visibility to the extent that would allow players to determine the lateral location (forehand or backhand) sooner in volleys compared to regular balls.
- Significantly shorter reaction times were observed for fast speeds than for slow speeds.
- The reaction time for the forehand volley was shorter than that of the backhand volley.
  o The benefits of the larger ball (to slow the game down) increase as the ball speed increases.

Racquet Vibration:
- Higher racquet acceleration levels were noted for the fast speed when compared to slow speed.
- The racquet acceleration for the forehand volley was found to be greater than that of the backhand volley.
- Greater vibration frequencies were found for the regular sized ball when compared to the oversized Wilson Rally ball.

Muscle Activity:
- Greater muscle activity was observed in the flexor carpi radialis (a muscle of the forearm that flexes and abducts the hand) for the backhand volley than the forehand volley.
- Greater muscle activity was found in the extensor carpi radialis (one of the five main muscles that control movement at the wrist) for the forehand volley than the backhand volley.

CONCLUSION

Overall, few significant differences among ball speed, ball type, and lateral location were found for muscle activity, racquet vibration characteristics and reaction times. However, the study did discover that oversized balls do have benefits in regards to the time players are allotted to position themselves for a volley return. In addition, these modified balls do not appear to have the negative consequences on player injuries that have been questioned by the tennis and medical communities.

YEAR PERFORMED 2002

YEAR PERFORMED 2002
INTRODUCTION-RATIONALE

Lower back injuries are common among competitive tennis players. General agreement exists that the stress placed on the spine from the movements required of tennis athletes is related to the development of degenerative disc disease in the lower back (lumbar spine).

Among tennis strokes, the serve may place more stress on the lumbar spine than the other strokes because of the repetitive trunk hyperextension that occurs with this portion of the game (when the racquet moves behind the body).

Acceleration of the racquet before ball contact is then accompanied by flexion and twisting of the spine. This cork-screw like motion places great stress on the lower back.

Unfortunately, little attention has been devoted to studying trunk movement in the tennis serve. Because of the great prevalence of lower-back injuries among tennis players, a better understanding of the underlying mechanisms involved in trunk motion during a tennis serve is needed.

It was hoped that the results of this investigation would provide implications for tennis related issues such as the selection of tennis skills, planning of training schedules, designing of rehabilitation programs, and the prevention of low back pain.

SAMPLE

Participants for this project were 19 university students who played tennis recreationally.

- Gender: males (n=17)
- Age Range:
- Average Height:
- Average Weight:
- USTA Rating (self-rated): 4.5-5.0 (advanced intermediate group) and 5.5 (advanced group)

PROJECT METHOD

- Participants were asked to perform recorded and analyzed while delivering the flat, topspin, and slice serves.

RESULTS

- There was no significant difference in lower trunk motion and muscle activation among the three types of serves.

- The advanced group showed higher activity in the muscle that runs vertically down the front of the abdomen (rectus abdominis), which may be related to the greater angles created by the athletes’ bodies when twisting to the left during the serve.

- Players in the advanced intermediate group may be more susceptible to back injury than the advanced players because they use significantly greater trunk hyperextension.

- Great stress is placed on the lower spine during the acceleration phase of all three serves because of the hyperextension posture required and the large activation of the front, back, left and right regions of the lower trunk muscles.

YEAR PERFORMED 2004

The purpose of the study was to examine:

- The role of the lower trunk muscles in providing stability of the lumbar spine during the tennis serve
- To speculate on the stress (load) placed in the lumbar spine during the tennis serve.

RECOMMENDATIONS

- Although highly-skilled competitive players are likely to have stronger vertebrae when compared to recreational or lower-level players, they are still susceptible to spinal injury.

- Because competitive players complete a large number of serves in practices and competitions, the accumulative stress on the lower spine can be detrimental.

- Past research has shown that spinal discs and ligaments are at greater risk of injury in the early morning when compared with later in the day because of a lack of movement and general activity.

- It seems reasonable to advise players with histories of back disorders to avoid activity that involves extreme range of motions in the lumbar spine (such as the tennis serve) in the early morning.

- The heavy involvement of lower trunk muscles in the tennis serve reinforces the importance of abdominal and lower back exercises in the strength and rehabilitation programs designed for tennis players.

- Because most lower trunk muscles undergo eccentric contractions (tension while the muscle is being lengthened) during selected phases of the serve, it is recommended that eccentric training is included in the conditioning programs of your players.

CONCLUSION

The strengthening of the lower trunk muscles will not only enhance performance, but will also benefit tennis players by preventing lower back injury and pain.
Muscle Activation in Coupled Scapulohumeral Motions in the High Performance Tennis Serve

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INTRODUCTION

• Previous studies have utilized EMG (Electromyography) to investigate muscles in the tennis serve and have measured intensity of muscle activation as a percentage of maximal voluntary isometric contraction. These studies measured muscle activation in the various phases of the serve and have found that each of the muscles were active during all phases of the serve at varying levels of intensity.

• This study provides greater detail of the muscle activity during the serve by investigating patterns and sequencing of muscle activation. Specific patterns of activation are established and a clearer picture of how coupled activations accomplish the motions and positions of the arm in the tennis serve is given. In addition, guidelines for goals and content of rehabilitation and conditioning programs are suggested.

METHOD

Analog to digital conversion was performed with a Data Translation A to D board and subsequent analysis of EMG data was accomplished on a Sun SPARC 330 workstation. The signal was rectified and the mean established for the quiet file. Each muscle was considered "on" when its amplitude was 3 SD points above baseline signal for a 25 ms window. The duration of activation was measured, and the muscle was considered to be "off" when the amplitude dropped below 3 SD above baseline signal.

• The subjects reported no differences in their motion from the surface or the indwelling electrodes and the mechanics of the service motions were noted to be unchanged after the electrodes were placed, when compared with the replaceplacemnt service motions.

• The normal service motion was accomplished by having each subject take as many trials as were needed to feel comfortable with the electrodes and wires. Once the subjects felt comfortable and warmed up, the study trials were performed, using a Tennis Target Trainer (Tennis Target, Burbank, California, USA) as the target to aim for. The target trainer was placed the same distance away from the subject, as the net is located from the baseline on the tennis court. A successful trial occurred when the ball went through the target. Each subject had to complete three successful service trials.

• Four NAC 60/200 Hz black and white high-speed cameras at 200 frames/s recorded each service motion, and the video data was used to track arm motion and to delineate the phases of the service motion as they related to the arm motion: cocking, acceleration, ball impact, deceleration, and follow-through. Ball impact was considered as time zero. Arm motion was measured as glenohumeral rotation and as humeral motion in horizontal plane abduction and adduction.

WHAT DID THE STUDY FIND?

• The serratus anterior (~287 ms before ball impact) and upper trapezius (~234 ms) were active in the early cocking phase, while the lower trapezius (~120 ms) was activated in the late cocking phase just before the acceleration phase.

• The anterior deltoid (~250 ms) was activated early in cocking, while the posterior deltoid (~157 ms) was activated later. The teres minor (~214 ms) was activated early in the cocking phase. The supraspinatus (~103 ms) was activated in late cocking.

• The infraspinatus (~47 ms after ball impact) was activated in follow-through. All muscles except infraspinatus were activated in duration of more than 50% of the service motion.

CLINICAL IMPLICATIONS

• One of the goals of a conditioning program is to optimise muscle activation and one of the goals of rehabilitation is to restore optimal muscle activation. This study suggests some guidelines towards those goals. As different parts of the same muscle (upper and lower trapezius, anterior and posterior deltoid) are activated at different times, and for different durations, during the service motion, they can act as separate muscles. Conditioning or rehabilitation exercises must be directed at activation of each part of the muscle in their proper position and function.

• Second, as the muscle activations start at the scapular stabilisers and proceed towards the rotator cuff, conditioning and rehabilitation exercises should adhere to the same progression. They should emphasise scapular stability and control as a basis for rotator cuff activation, and should integrate the training of the muscles along kinetic chain principle. Eccentric activation of the scapular stabilisers, the anterior deltoid and the posterior deltoid should be implemented, and plyometric or stretch/shortening activities with medicine balls or tubing should be emphasised. A stable scapular base is required for maximal rotator cuff activation, so rotator cuff emphasis should be delayed until adequate scapular control is achieved.

• Third, most of the muscles are activated for a high percentage of the duration of the tennis serve motion. This implies that part of the training of these muscles should involve endurance exercises. The early activation of the serratus anterior in the cocking phase shows that this muscle should be rehabilitated as a scapular external rotator. The patient can progress to rotator cuff exercises after scapular control is regained.

CONCLUSION

This study demonstrates that there are patterns of activation of muscles around the scapulohumeral articulation in the normal accomplished tennis serve. Rehabilitation and conditioning programs for tennis players should be structured to restore and optimize the activation sequences (scapular stabilizers before rotator cuff), task specific functions (serratus anterior as a retractor of the scapula, lower trapezius as a scapular stabilizer in the elevated rotating arm) and duration of activation of these muscle.

REFERENCES


