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The influence of Spraino© on performance and safety in badminton

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6TH **WORLD CONGRESS OF RACKET SPORT SCIENCE**

BOOK OF ABSTRACTS

25-26 May 2018 | **Bangkok, Thailand**

Editors Miran Kondrič | David Cabello Manrique | Metta Pinthong

Book of abstracts

of
The 6th World Congress of Racket Sport Science

Bangkok, 25th – 26th May 2018

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of

The 6th World Congress of Racket Sport Science

Editors:
Miran Kondrič, PhD
David Cabello-Manrique, PhD
Metta Pinthong, PhD

Editorial board/reviewers:

Organizing Committee

Message from Badminton World Federation

BWF President's Message

On behalf of BWF, it is my pleasure to welcome you all to Bangkok and to the 6th World Congress of Racket Sport Science.

The World Congress on Racket Sport Science is jointly organised by the Badminton Association of Thailand, the International Table Tennis Federation, Mahidol University and Badminton World Federation, and supported by the International Tennis Federation. My sincere thanks to all our partners for this collaboration. I would also like to express my gratitude to the organising committee and to the hosts for their generous support and excellent arrangements.

The congress will provide a forum for you to update your knowledge and explore innovations in sport science which substantially influence the present and future of competitive racket sports. It will also offer a platform for networking, providing you with the opportunity to interact with leading scientists, researchers, and other innovators in this field.

The congress will cover a range of topics, including data, biomechanics, injuries, and sports nutrition. As you can see, there is a lot of emphasis on physical and mental well-being of our athletes. It is our responsibility to give our athletes and our larger community of sport enthusiast's access to the latest developments in sport science.

I'm sure you will enjoy the congress and that your interaction with your peers from other countries will stimulate a creative exchange of ideas and will be personally rewarding. I hope you will join us in watching the action at the TOTAL BWF Thomas & Uber Cup Finals – our showpiece men's and women's team championships. Have a wonderful week in Bangkok!

Poul-Erik Høyer
BWF President

Message from Organizing Committee

Organizing Committee Chair's Message

During the TOTAL BWF World Championships 2017 in Glasgow, Scotland, I, as President of the Badminton Association of Thailand (BAT), was approached by representatives from the Badminton World Federation (BWF) and the International Table Tennis Federation (ITTF) to organize and host the 6th World Congress of Racket Sport Science during the Total BWF Thomas & Uber Cup Finals 2018, taking place in Bangkok, Thailand on 20-27 May 2018. Although BAT will be very busy during that time, I decided to accept the responsibility to organize and host the 6th World Congress of Racket Sport Science, which, I believe, will bring a lot of great things to Thailand not only in terms of racket sports but also in sport tourism. To co-organize the event, I invited the College of Sports Science and Technology, Mahidol University, the leading sport medical university in Thailand. The invitation was gladly accepted and everything started from there.

Nowadays in the world of competitive racket sports, everyone is looking to get an edge over their competitors. A lot of research has been done to study the factors that substantially affect match results. The scientific fields regarding coaching, biomechanics, ergonomics, fitness, injuries and their prevention, nutrition, physiology, rehabilitation and training are just some examples of ongoing research. The World Congress will bring together many different disciplines of racket sports science, as well as providing the opportunity for scientists, coaches, medical doctors, psychologists, physiotherapists and anyone else who is interested in racket sports to meet and discuss the development of the games.

Since we began organizing the World Congress in the fourth quarter of 2017, the Organizing Committee has been working very hard to promote the event both locally and internationally. We have had a lot of interest from scientists of many nationalities from all over the world. A great amount of abstracts in various disciplines in racket sports were submitted, demonstrating the increasing interest of sport scientists to dedicate their time to racket sports.

As Chair of the Organizing Committee, I would like to thank all three international federations of racket sports for giving BAT the opportunity to organize and host the World Congress, the College of Sports Science and Technology, Mahidol University, for co-organizing the event, and all members of the Organizing and Scientific Committees for their excellent work and support. We look forward to welcoming all international participants to Bangkok, Thailand, as well as great discussion, knowledge exchange, new friendship and wonderful camaraderie in the World Congress.

Khunying Patama Leeswadtrakul
IOC Member
President, Badminton Association of Thailand
Chair, Organizing Committee

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BANGKOK 2018

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SCIENCE AND RACKET SPORTS: PAST, PRESENT AND FUTURE

Abstract

In 1993 delegates assembled to attend the very first World Congress of Science and Racket Sports. Twenty-five years later as we assemble for the sixth Congress, it is timely to reflect on the achievements of the Science and Racket Sports movement. It is an opportunity to identify the areas of scientific application that have proved to be most fruitful, to evaluate influence of applied research on our understanding and practice of racket sports, and to assess the impact of the scientist-coach-player triad on coach education and performance in the various racket sports.

It is also timely to consider the current status of the Science and Racket Sports movement. The growth in quantity and quality of applied racket sports research, the expansion of formalised coaching qualifications, the increasing interest and support given by the International Federations are all factors which provide a solid foundation to the movement.

The challenges that the future provides are always with us. Specifically, the Science and Racket Sports movement is now in a position where it has to decide on its future direction. The solid foundation it currently has could well be a springboard for the formation of an International Society with formal membership and officers. Links with the International Federations, already good, could be developed further. Support and sponsorship, targeted research programs, workshops to assist the professionalization of racket sports coaching. These are all exciting possibilities the future may offer. This congress provides an opportunity to debate these possibilities and to decide the future identity of Science and Racket Sports to serve it for the next twenty-five years.

Key words: *biomechanics, performance analysis, physiology, psychology, history*

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PHYSIOLOGY OF RACKET SPORTS: IMPLICATIONS FOR TESTING, TRAINING & RECOVERY

Abstract

This lecture gives an overview about the physiological demands of competition and training in racket sports with a special emphasis on tennis. Results from multiple studies related to the physiological and psychological work load profile of competitions during real tournaments and during training are compared to the metabolic demands of continuous exercises such as running. The specificities of racket sport competition are pointed out as important guidelines for the prescription of trainings drills and the construction of fitness tests. Beside of more general guidelines, individualized concepts for training prescription based on specific testing results and the daily monitoring of fatigue and recovery are presented. Short and long-term effects of different recovery interventions (e. g. cold water immersion, active recovery, foam rolling) as well as the usefulness of nutritional supplements (e. g. creatine monohydrate) are discussed. Implications from tennis related findings to research and practice in other racket sports will be pointed out. Participants will understand more about the importance of a close relationship between theory and practice and will get evidence based take home guidelines.

Key words: *physiology, adrenaline, nervousness, carbohydrates, creatine, fartlek, monitoring, recovery*

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HOW BIOMECHANICS IMPROVE BADMINTON TECHNIQUES

Abstract

Badminton is one of the very popular racket sports in the world. Badminton techniques include the upper limb techniques such as the under arm, side arm, overhead strokes, net shots, and footwork and the body control. Biomechanics is a specific sport science that aims to describe the mechanical features to improve performances and reduce injuries. Comprehending the knowledge of biomechanics could help us to increase the efficiency for badminton learning and training. In this session, I would like to introduce how researchers can improve the badminton techniques from previous researches and principals of biomechanics. The notational analysis has been widely applied to analyse the position, techniques repetition, time durations and tactics during the matches in racket sports. We can understand the framework of a badminton game from the notational analysis. It helps us to know what the most important techniques of badminton game are and tell us how to set up appropriate physical fitness training programs. We rectify the techniques of our players by recording their motions and compare them with elite players' data. We can analyse the movement of badminton techniques by the kinematics approach. Or we can analyse the inter-segments data with the inverse dynamics method and use the EMG signal analysis to confirm the finding. So we can understand the sequence of the muscle groups to accomplish the techniques and know what the dominate muscles in the movement are. We use the force platform to measure the reaction pattern and the GRF variables of the footwork and calculate the force and moment of joints of lower limbs. In the biomechanics engineering, the researchers used accelerometers to measure the coordinate acceleration, vibration and shock of different designed rackets and shoes. The finger pressure analysis helps to know the grip force of different badminton strokes and identify the fingers that dominate the badminton strokes. The future rackets might mount with the MEMS device to detect the dynamic data of the racket during the match and training. The researchers, teachers and coaches can interpret the motion of the badminton techniques from the finding of previous researches and proper biomechanics principals.

Key words: *technique analysis, notational analysis, inverse dynamics, EMG, GRF*

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TALENT IDENTIFICATION AND DEVELOPMENT IN BADMINTON

In the last decades, various sports federations have been seeking scientific evidence that facilitates the search for young talented athletes. In order to become successful at international competitions in the sport of badminton, it is critical that a development pathway be created. Such pathways are important as it is well known that the road from beginner to sports champion is a long and unpredictable one, therefore, choosing a sport that fits a child's individual characteristics is essential for keeping them involved in their chosen sport. The lack of allocated resources towards a talent identification program by sports federations means that alternative methods must be sought to assist with the prediction of sporting elite and the minimizing of talent loss. Promoting healthy sports participation, which leads to exceptional athlete pathways, is far more interesting and vital than the actual 'survival of the fittest' pathway to the podium. Talent detection in primary schools should be the first step as the advantages are numerous and children learn to make choices, which are beneficial for their autonomy and competence. This session will focus on the transition from theoretical sport science models to an applied scientific badminton system.

Key words: *talent detection, identification, development, orientation and selection*

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THE INITIAL TAKE-OFF TIMING IN BADMINTON FOOTWORK

Abstract

The footwork is one of the most important techniques in a badminton game. The complete footwork movements of the badminton include the preparation, initial take-off, landing, decision making and setting off to move to hit the shuttle. In this session, I would like to present some discoveries in the badminton footwork analysis. One of the most debatable queries in the front court forward step footwork is what the appropriate forward steps to the forehand front court footwork to return the shot will be? We hope to illustrate the badminton forehand footwork to the front court and landing biomechanics characteristics during defensing using a force platform and 3D movement analysis system. We compared the biomechanical data between 2 and 3 forward steps in the movement time, GRF and inverse dynamics. The research revealed that there were significant differences among 2 and 3 forward steps in the movement time, GRF and inter-segmental dynamics data. We also found that the lower limb muscle contraction pattern of forward steps in landing period. The major doubt was how the initial start footwork of the badminton single players did when they were confronting the opponent's backcourt forehand overhead strikes. We compared six direction movements of the defensive players' dynamical data when they were moving to return the strikes by the opponent. We found that there were no significant differences in the very beginning of the take-off movements among six directions footwork. We found interaction between the offensive and defensive players. The initial take-off timing of the defense preparation occurred around the opponent was striking the shuttles and the main propulsive leg exerted in different movement directions. The different biomechanical characteristics of reaction time, movement time, COG pattern, GRF and inverse dynamics information among six direction footwork before and after propulsion phase. The different lower limb stiffness, horizontal GRF and total reaction time among the six directions to return the opponent's strikes. If the players would like to have a better return in badminton competition, they should perform the correct pushing direction and propulsive peak GRF during a short period of time after the strike point. We hope the results of the studies will provide some thoughts for the teachers, coaches and the biomechanical researchers.

Key words: *GRF, reaction time, lower extremity, stiffness, forward steps*

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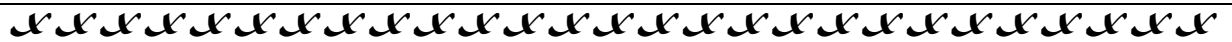
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INJURIES IN RACKET SPORTS

Abstract

The purpose of this topic is to review some causes of injuries in racket sports and the appropriate time to return to play. This study will present not only common racket sport injuries which are associated with overuse training but also the rare injuries from the patients that we have met and how to deal with them. To deal with the injuries, we should adjust for biological, mechanical and psychological factors that affect the patient which will determine the duration before coming back to pre-injury level. Intrinsic and extrinsic risk factors may be related to the incidence of injuries. These factors may be evaluated by a comprehensive examination and knowledge of tissue healing, so preventive strategies may be implemented.

Key words: *injuries, racket sports, review, factors*

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SPORT PSYCHOLOGY: THE MISSING PART OF BADMINTON PEAK PERFORMANCE

Abstract

In sport for competition, we mainly focus on winning and losing. Bobby Knight, the legendary basketball coach from Indiana University, had a slightly different perspective when he said that the key in fact is not the will to win, because everybody has that, it is the will to prepare to win that is important.

The above ideas are the principal philosophies of those who want to be successful athletes. If we adopt these ideas, the rest of the components for success (physical, skill and mental) will follow. This indicates that psychology plays a large part in success in sport since we accept that our mind controls our body and our thoughts govern actions. An example of this a Thai badminton player, is Ratchanok Intanon, former world number one and currently top 5 in world ranking, who won 317 tournaments, not only from her skill and physical components, but from her psychology skills as well. Her mental ability during training and competition played a vital role. She needed to be tough during training as well as competing.

There is an amount of research evidence which confirms that psychology can enhance athlete performance (Gardner & Moore, 2004; Gould, Dieffenbach & Moffett, 2010; Smith, Smoll & Cumming, 2007). These findings however need to be applied to athletes appropriately. These applications need also to be made regularly and systematically in daily practice. One last requirement for the application of psychology for athletes is that the quality and ethics of services must become the utmost of professional concern.

This special talk then will share with you the importance of the psychological perspective of sport competition success. Finally, this talk will address why we miss psychology as part of our preparation for the success of badminton.

Key words: *sports psychology, performance, badminton, mental ability*

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SPORTS NUTRITION FOR HIGH PERFORMANCE

Abstract

Nutrition is one of the key factors that can have a significant impact of an athlete's performance. Food does not only provide the essential macro- and micronutrients needed for daily living, but it can facilitate effective training, promote speedy recovery and therefore the overall training adaptation. Eating carbohydrate and drinking fluid before and during exercise ensures that an athlete starts the training session in a euhydrated state with ample energy to train and perform to their maximal capacity. High quality protein, taken at the right dose and at the right time can also promote muscle mass gain and repairs muscle damage. Intake of fluid and electrolytes are sometimes overlooked especially in hot conditions, however, significant dehydration has been shown to affect performance. For many athletes, performance can be supported through real foods, with the help of sports food during specific training sessions and competition. Certain performance supplements, that are well-supported by scientific evidence, if taken in the right situation, can significantly enhance performance. However, many athletes fell into the supplements hype and resort themselves to supplements that are not scientifically-proven and at high risk of contamination from WADA-banned substances. This session will provide both theoretical and practical nutrition information that can be applied to both active individuals, as well as top elite athletes.

Key words: *food, fluid, protein, recovery, supplements*

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CHALLENGE ANALYSIS AND COUNTERMEASURE OF TRADITIONAL TABLE TENNIS TRAINING IN 40 + ERA

Abstract

Table tennis has been in the 40+ era for more than three years. According to the observation of the three major world events, none of the world's top athletes has fully entered the age of 40+. There is a hidden danger that technology is strong and tactics are not strong. According to the analysis, there are some problems in the traditional training of our country that the technique and tactics are separately practiced (technology prior to tactics), which will lead to the phenomenon that "the athlete is out of touch" with the minor athlete. The consequence directly affects the mastery of athlete's tactical ability. In this context, the author based on the convergence technology as a theoretical basis, a comprehensive analysis of the new problems facing the 40+ era and reflect on the impact of China's technical and tactical training factors; to solve our traditional technical and tactical training problems.

Key words: *40 + era, convergence technology, race training out of touch*

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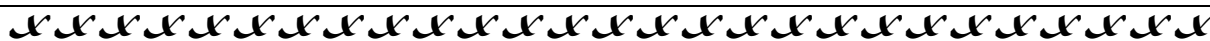
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FEATURES AND PREVENTIVE MEASURES OF OCULAR INJURIES CAUSED BY BADMINTON

Abstract

Objectives: To study features and preventive measures of ocular injuries caused by badminton. **Methods**: Sixty patients with eye injuries during badminton play were included. Type of injure (non-penetrating or penetrating), game (singles or doubles), instrument of injury (shuttlecock or racket), and instigator of injury (partner or opponent), correction of refractive error, professional training were recorded. **Results**: Injuries in 56 patients were non-penetrating and 4 were penetrating. Eight occurred in singles game and 52 in doubles game, 15 were hit by opponent and 37 by partner. Forty-two patients were hit by shuttlecock and 18 by racquet. Seven patients wear contact lens and 9 wear spectacles. Seventy-five percent of injured players and 84% of instigators had not been trained professionally. **Conclusions**: Doubles players are at higher risk of badminton-related ocular injuries. More players were hit by their partners than by opponents. Injuries caused by racket are less common but more severe than by shuttlecock. Players should be advised to avoid looking back at their partners. We suggest not wearing spectacles due to increased risk of penetrating ocular injuries. It is necessary for amateurs to get professional training and use protective eyewear to avoid ocular injuries. Monocular blind players should avoid badminton play.

Key words: *badminton, ocular injuries, sports-related injury*

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DEVELOPMENT OF BIOMECHANICAL FEEDBACK TRAINING FOR LEARNING BADMINTON SMASH

Abstract

The two key components in motor learning are practice and biofeedback. Previous studies have shown that, when properly understood and applied, biofeedback can strongly enhance the practice of human motor skills. The goals of this study were to determine the characteristics related to full-body control on smash quality in order to develop biomechanical feedbacks that could help learn/acquire the skill efficiently. Using a 10-camera, 3D motion capture system and 15-segment, full-body biomechanical model, 14 skilled and 15 novice players were measured and analysed. The study has successfully identified two key biomechanical feedbacks – body positioning and trunk rotation, which need extra attention during teaching and learning. The findings suggest that for training a proper positioning, one could conduct a self-selected comfort position towards a statically hanged shuttlecock and then step one and half feet back – a practical reference marker for learning. Furthermore, training intended to increase the efficacy of this skill needs also to focus on how the trunk rotation is incorporated into the kinematic chain of the arm and the racket. As one gains experience through repetitive training, improved limbs' coordination would increase smash quality continuously.

Key words: *3D motion analysis, body positioning, trunk rotation*
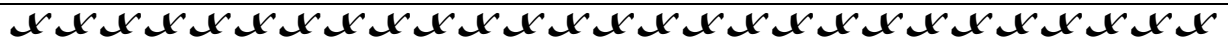
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BIOMECHANICAL QUANTIFICATION OF THE KEY PARAMETER RELATED TO THE FOREHAND OVERHEAD SMASH IN BADMINTON

Abstract

One of the dominant skills in badminton is the forehand overhead smash, which consists of 1/5 attacks during games. Empirical evidences show that one has to adjust the body position in relation to the coming shuttlecock to produce a powerful and accurate smash. A search of literature has shown that there is a dearth/lack of study on this fundamental aspect. The goal of this study was to determine the influence of positioning on smash quality in order to discover information that could help coaching. Using a 10-camera, 3D motion capture system (VICON, 200 frames/s) and 15-segment, full-body biomechanical model, 10 skilled and 10 novice players were measured and analysed. Results have revealed that the body positioning has direct influence on the quality of a smash, especially on shuttlecock release angle and clearance height (passing over the net) of offensive players. The results also suggest that, for training a proper positioning, one could conduct a self-selected comfort position towards a statically hanged shuttlecock and then step one foot back – a practical reference marker for learning. This perceptional marker could be applied in guiding beginners learning. The researchers hope that the findings will benefit practitioners for developing effective training programs for beginners.

Key words: *biomechanical modelling, shuttlecock release speed & angle, clearance height*

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COMPARISON OF COMPETITIVE SKILLS AND TACTIC AMONG VARIED DOUBLE TEAMS IN SOFT TENNIS

Abstract

This study aimed to analyse the different competitive skills and tactic among varied double teams in soft tennis. Research samples were the top four from men's doubles, women's doubles and mixed doubles in 7th Asian soft tennis championship. Nine matches were analysed by recording observation on a few skills including type of serve, serve placement, serve and volley skill, return placement, return and volley, scoring shots, as well as scoring skills and formation. SPSS 20.0 for Windows were used for statistical analysis. Comparison of groups were analysed by Chi-square test with significance level set at 0.05. Result showed that men's doubles, women's doubles and mixed doubles had significant difference in three skills which are return placement, return and volley, and scoring formation (p<0.05). Findings showed that firstly, although all three double teams mainly scored by crosscourt baseline stroke, men's doubles tended to attack via short ball crosscourt, women's doubles inclined for down the line lob, while mixed doubles preferred down the line attacking the net player. Secondly, men's doubles and mixed doubles used approach shot for return of service more than 50% during the game but the strategy was not observed in women's doubles. Thirdly, scoring formation in men's double involved "Double Net Parallel Formation"; while women's doubles and mixed doubles favoured "Up-Back Formation". This study suggested coaches to consider a team-cantered strategy for a more effective training for doubles in soft tennis.

Key words: *men's doubles, women's doubles, mixed doubles, double net parallel formation, up-back formation*
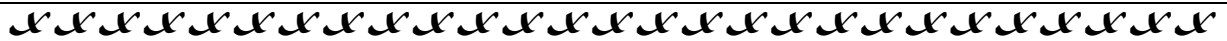
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A COACHES' PERSPECTIVE ON THE CONTRIBUTION OF ANTHROPOMETRIC MEASURES, PHYSICAL PERFORMANCE, AND MOTOR COORDINATION TESTS IN TABLE TENNIS, TENNIS, AND BADMINTON

Abstract

Talent identification in sports is of extreme importance at an early stage, so that there can be a higher rate of success later on in one's athletic career. Yet still, there are many who are unaware of its importance and what can be done to achieve it. Thus, in this study, three popular racquet sports: table tennis, tennis, and badminton were taken into consideration for identifying key characteristics with regards to a coaches' survey that was done. One hundred and seventy-seven licensed and professionally diverse coaches worldwide completed a survey based on anthropometry, physical performance, and motor coordinative skills. MANOVA was used to identify vital similarities and differences that exist between the three racquet sports. Coaches indicated the importance of a particular talent characteristic to their sport on a scale of 1 to 10, and the discriminant analysis correctly allocated coaches for table tennis, tennis, and badminton respectively at 81.01%, 55.6%, and 71.4%. This study reflects the important role that talent identification models possess with regards to talent orientation and talent transfer.

Key words: *table tennis, tennis, badminton, talent identification*

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A RESPONDER ANALYSIS OF THE TABLE STARS @SCHOOL INTERVENTION IN PRIMARY SCHOOL CHILDREN (6-12 YEARS) – PRELIMINARY RESULTS

Abstract

This study aimed to delineate characteristics of the responders in a controlled trial comparing the TABLE STARS @school (TS) intervention with regular physical education (C) in Dutch primary school children (6-12 years). An intervention school (TS; n=102, ♀43, ♂59) and a control school (C; n=75, ♀33, ♂42) were recruited. All children were measured at baseline (T0) and after the intervention period of 5 weeks (T1) regarding their balance (static and dynamic), ball control skills (dribbling and catching) and their selective attention. The TS intervention was provided during the regular physical education classes once a week and consisted of fundamental exercises for table tennis (e.g. hitting, aiming and balancing). No specific technical table tennis skills (e.g. strokes) were trained. Responders needed to improve more than their age-peers of the control group (i.e. > mean difference between T1 and T0 of the control group) on at least three of the four motor tests or the selective attention test. Independent sample t-tests were used to elucidate differences between the responders and non-responders regarding their baseline characteristics. Approximately 20% and 60% of the intervention group were identified as responders regarding motor skills and selective attention, respectively. 'Motor' responders scored significantly lower than the non-responders on static balance (p=0.025) and catching (p=0.05). 'Attention' responders were significantly older (p=0.06) and for that reason significantly better in the balancing and catching tasks ($p<0.05$). The results indicate that up to 60% of children in a regular primary school can benefit from the TS intervention; the lower performers on motor skills (6-12 years) are likely to improve on balance and ball control and specifically the older children (10-12 years) are likely to improve their selective attention.

Key words: *psychomotor performance, mental processes, child, racquet sports*

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STUDY OF SHOULDER POSTURE IN BEIJING SPORT UNIVERSITY TENNIS PLAYERS

Abstract

Objective: To study the features of shoulder posture of Beijing Sport University tennis team members. Methods: Assess the shoulder posture of 18 elite tennis team members. Secondly, interview two coaches in tennis team for information about skill training and physical training. Results: Beijing Sport University tennis team players almost exist abnormal shoulder posture. Conclusion: Beijing Sport University tennis team players almost existed abnormal shoulder posture, and abnormal shoulder posture was related to training, including the local load of shoulder is too large and lead to fatigue and imbalance power of rotator cuff muscles, lack of strength training for weak shoulder muscles, the lack of warm-up activities of the shoulder muscles and stretching and relaxation. School tennis team training should add shoulder rehabilitation functional exercise.

Key words: *tennis, training, shoulder, posture*

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SPORTS INJURY INVESTIGATION AND RISK ASSESSMENT OF NATIONAL FEMALE TENNIS PLAYERS

Abstract

For completing the requirements of reducing the injury rates for national female tennis players, we collect the information of sports injuries by questionnaire, carry out the ROM test and muscle length test to assess the risks of injury from 13 national female tennis athletes. Results: The national tennis players have a high rate of injuries, especially in wrist (28%), low back (23%), shoulder (17%), knee (15%) and so on, and the injuries in dominant side (49%) are more than the nondominant side (28%). Chronic injuries have the higher incidence than acute, mild is the most common injury degree, and moderate and long-term injuries are common. In the injury risk assessment, there are specific tennis changes in the muscle length and ROM, players have high injury risk in the assessment, indicating that injury is related to the changes in muscle and body structure caused by tennis training, the results help us to build the training system of prerehabilitation which providing the guidance for further training.

Key words: *tennis players, injury questionnaire, risk assessment, prerehabilitation*
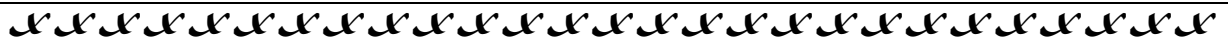
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3S THEORY FOR CASE ANALYSIS: TACTICAL CHARACTERISTICS OF TWO TALENTED YOUNG TABLE TENNIS PLAYERS

Abstract

Purpose: This study analysed the tactical characteristics of two talented young table tennis players. **Method**: The two talented table tennis players analysed here are Tomokazu HARIMOTO (fourteen years old, Japan) and Yun-Ju LIN (fifteen years old, Taiwan). The scope of the study was to analyse HARIMOTO's and LIN's tactical characteristics using the 3S (speed, spend and spot) theory. The data was collected from the singles matches which HARMITO and LIN played against Hugo CALDERANO respectively in 2017 Czech Open and was included from serve to the fifth stroke in the matches. The tactical characteristics of each of them were summarized for training other young table tennis players in the future. **Results**: In serving, both players served forehand, slow speed, side back spin, and near net, but HARIMOTO's landing spots were at the forehand position (36.76%), while LIN's at the middle position(46.27%). In receiving, HARIMOTO's primary return characteristics were backhand twist (33.33%), medium speed (47.83%), top spin (56.52%), and the backhand position (33.34%). As for LIN, his primary return characteristics were backhand twist (67.12%), medium speed (47.95%), top spin (72.60%), and the middle position (45.21%). In the third stroke, HARIMOTO's primary return characteristics were drop shot (17.66%), strong speed (41.18%), top spin (66.67%), while his landing spots were evenly distributed at the three main areas. As for LIN, his major characteristics were backhand twist (36.67%), medium speed (50%), top spin (80%), and the middle position (36.67%). It the fourth stroke, HARIMOTO's primary characteristics were fast push (22.58%), medium speed (64.52%), top spin (67.74%), and his landing spots were mostly between the backhand position (32.26%) and the middle position (32.26%). As for LIN, his primary characteristics were block (27.27%), strong speed (40.91%), top spin (70.45%), and the backhand position (29.54%). For the fifth stroke, both HARIMOTO and LIN used drive and block most frequently, but in terms of the speed, HARIMOTO paired strong speed (41.67%) with medium speed (37.50%), while LIN medium speed (53.85%) paired with strong speed (30.77%). For the landing spots, HARIMOTO's spots were evenly distributed among the three areas, while LIN's were mostly at the backhand position (20.83%).

Key words: *table tennis, 3S theory, talent athletes, technique and tactics*

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A QUALITATIVE EXAMINATION OF COPING STRATEGIES IN INTERNATIONAL TENNIS UMPIRES

Abstract

The role of officials in all sports fields has always been accompanied by stress and anxiety. Tennis judgement is also a very exciting occupation and a stressful one in any stage．As the best performance cannot be expected from athletes and coaches who are under a great deal of stress, officials are sometimes unable to demonstrate proper performance. Therefore, the purpose of the study was to investigate the coping strategies in the international tennis umpires. Five umpires with International Tennis Association budges of gold, silver, or bronze were interviewed about the coping they experienced as international umpires. At the time of the interview, the average age of the participating umpires was 46.1 yr. with a range of 37 to 52 yr. Qualitative interviews were between 35 and 60 minutes long and were transcribed, coded, and analysed by three experienced qualitative researchers. Forty-one raw data themes were identified from the analysis of the interview data. These raw data responses were content analysed. Dimensions of coping strategies were identified, including problem-solving, positive reappraisal, avoidance, seeking social support, information seeking, and distraction. The information gathered from this work also provides insight into the creation of better stress management programs for this population.

Key words: *tennis umpires, coping, stress management*

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DIFERENCE OF VISUO-SPATIAL WORKING MEMORY CAPACITY IN TABLE TENNIS PLAYERS WITH DIFFERENT LEVELS OF SKILL: AN ERP STUDY

Abstract

The modified non-delayed and delayed matching- to-sample test has been used in several studies for measuring visuo-spatial attention and working memory. The main purpose of the present study was to compare visuo-spatial working memory performance among table tennis players with different skill levels. Eighteen highly skilled table tennis players (mean age 20.2 years, SD = 1.4), 18 amateurs table tennis players (mean age 22.1 years, SD = 3.21), and 18 nonathletic controls (mean age 21.2 years, SD = 1.2) were administered visuo-spatial attention (non-delayed condition) and working memory (delayed condition) task while the reaction time and response accuracy were measured. Results showed that both highly skilled and amateurs groups had shorter reaction time. These findings suggest that table tennis players, regardless of skill levels, have superior visuo-spatial cognitive performance. These findings could be useful for talent identification and development in table tennis.

Key words: *cognition, racket sports, open skill, athlete*

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ACUTE EFFECT OF LACTOSE-FREE SKIM MILK AND SPORT DRINK INGESTION ON POST-EXERCISE PERFORMANCE OF COLLEGIATE BADMINTON ATHLETES

Abstract

The current study looked into the acute effect of intake of lactose-free skim milk (LFM) vs sport drink (SD) on post-exercise performance. This was part of a larger study done on effect of lactose-free milk on intermittent athlete's recovery post anaerobic exercise. Eleven collegiate badminton athletes (5 male and 6 female, Mean age = 19.6±1.7 yrs, Weight = 56.8±5.03 kg) volunteered to participate in this crossover design study, with ≥7-day washout between trials. After a 2-hr training session, the participants rested for 2 hours and ingested the same volume of either LFM or SD, matched for carbohydrate content of 1.0 g CHO/kg body weight. Two badminton-specific agility tests and a shuttle run were done post-ingestion. The research was reviewed and approved by the Mahidol University Central Institutional Review Board. No significant difference between LFM and SD groups was found in terms of aerobic capacity $t(10)=.147, p=.886$ and agility (test 1: $t(10)=.191, p=.852$ and test 2: $t(10)=.397, p=.700$). No differences were found for heart rate measured at different time points during the performance tests. Lactose free skim milk and an isovolumic sports drink had similar effects on subsequent aerobic and anaerobic performance of badminton athletes.

Key words: *lactose free skim milk, collegiate badminton, aerobic capacity, agility*

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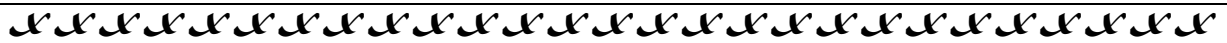
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EFFECTS OF TRAINING PROGRAM USING TABLE TENNIS BALLS WITH VARIOUS SIZES ON THE PERFORMANCE LEVEL OF SOME ATTACK AND COUNTERATTACK SKILLS OF JUNIOR TABLE TENNIS PLAYERS

Abstract

The current research aims to design a training program to improve some attack and counterattack skills for junior table tennis players (less than 18 years) and to identify its effects, using three different sizes of table tennis balls (big 55 mm ball – medium 44 mm ball – small 40 mm ball) on the performance level of the skills under investigation. The researcher used the experimental approach. Participants (n=21) were purposefully chosen from table tennis team of Gharbia governorate less than 18 years who are registered in the ETTF during 2017-2018 season. Participants were divided into three equivalent groups (7 players each). A sport-specific table tennis test battery was used for measuring physical and technical skills after verifying its validity and reliability. The recommended program lasted for (12) weeks. The researcher performed (t) test and LSD test for treating data statistically. Results indicated that using big 55 mm table tennis balls (bigger than regular game balls with 15 mm) improved the attack skills of the first experimental group compared with the other two groups. It also led to the following attack combination: forehand spin - forehand smash – third ball attack, using medium 44 mm table tennis balls (bigger than regular balls with 4 mm) improved the counterattack skills of the second experimental group compared with the other two groups. It also led to the following counterattack combination: smash hit against smash hit – random counterattack with any hit type against any hit type – open counter attack

With both forehand and backhand against top spin/lateral spin front/back loop.

Results suggest that the best table tennis ball for training attack skills for junior table tennis players less than 18 years is the big 55 mm table tennis ball, while medium 44 mm table tennis balls are best used for training counterattack skills.

Key words: *table tennis, attack, counterattack, ball size*

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RESEARCH OF HEALTH-RELATED FITNESS TOWARD UNIVERSITY STUDENTS: A CASE STUDY OF NCHU RACKET SPORTS STUDENTS IN 2017

Abstract

Purpose: The aim of this study was to investigate the health-related fitness status from National Chung Hsing University students in 2017, and to compare the differences of health-related physical fitness among students in various racket sport courses. The result would be taken to estimate and adjust the PE courses. **Methods:** The subject of this study was the students in table tennis, badminton and tennis courses in NCHU, including 736 male and 415 female students. The test items include body mass index (BMI), the 1 min set-ups, the site and reach, long jump, and the 800/1600 run/walk. All the data was analysed by Descriptive Statistics and one-way ANOVA. **Results:** 1.Male in items of the site and reach and long jump were poorer than normal model, and female in items of 1 min set-ups and 800 run/walk were better than normal model. 2. There were significant differences on male in long jump after three various courses, and badminton and tennis students in long jump scores were better than table tennis students. Besides, there were significant differences on female in 1 min set-ups and 800 run/walk after three various courses, and tennis students in1 min set-ups scores and 800 run/walk scores were better than table tennis students.

Key words: *National Chung Hsing University, physical fitness test, racket sports*

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THE RELATIVE AGE EFFECT AND BIOLOGICAL MATURITY IN ELITE YOUTH TABLE TENNIS PLAYERS – THE DUTCH CASE

Abstract

The relative age effect (RAE) in sports refers to the inhomogeneous distribution of the players' birth dates in one age category and its consecutive effects. It appears that in many sports the children who are born early after the reference date are more likely to experience success and to sustain participation. This can lead to an unfair environment regarding training and competition. This study investigated the birth distribution of Dutch elite youth table tennis in the age categories U11, U13, U15 and U18. It was also studied whether the players from different birth semesters differ regarding biological maturity. Data of 159 Dutch elite youth players (9-18 years, ♂83, ♀76) were included: birth semester (first or second after the reference date), birth cohort, sex and the predicted age to peak height velocity (pAPHV). Based on the results of this study can be concluded that 1.) elite youth table tennis in the Netherlands is at risk for a RAE at certain age categories and specifically the younger birth cohorts within an age category and 2.) that the relatively younger elite players of the second semester have a significantly lower pAPHV (i.e. are more mature) than their older peers, which seems too beneficial to survive at the elite level in this context.

Key words: *racquet sports, youth sports, age to peak height velocity, birth-date*

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PERFORMANCE IN VERTICAL JUMP AND USE OF ELASTIC ENERGY IN BADMINTON PLAYERS

Abstract

The research seeks to verify the performance in vertical jump and use of potential elastic energy in 12 Brazilian badminton players (7 men and 5 women). Anthropometric measurements were performed (weight and height) and then the vertical jumps: Squat jump and countermovement jump. The characteristics of these players were respectively: mean age of 15.58 ± 2.39 years, mass 58.21 ± 11.99 and height 166.67 ± 10.63. There was a difference in performance between men (29.38 ± 6.42) and women (16.96 ± 4.65) in squat jump, as well as in countermovement jump (men 27.06 ± 5.94 and women 17.77 ± 5.22). As for the elastic energy, women obtained $4.49\% \pm 0.05$ and men $7.17\% \pm 4.07$. These values are below ideal according to the literature, suggesting more studies with this proposal due to the importance of these variables for the planning and performance of athletes.

Key words: *badminton, vertical jump, elastic energy*

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MUSCLE-STRENGTH-RATIOS IN PARA-BADMINTON - WITH SPECIAL CONSIDERATION OF THE TRUNK MUSCLES

Abstract

Since in Badminton / Para-Badminton the entire body (bilaterally and unilaterally) is integrated in the movement pattern, it is of major interest to examine how strength values and ratios are represented in competitive athletes in terms of sports-specific balances or imbalances. Upper and lower body strength and trunk muscle function have been pointed out as important factors to be successful in Para-Badminton competition. Strength and trunk instability due to impairments, disabilities and handicaps can have adverse effects on posture, function and movement.

22 German national para-badminton athletes were examined by performing maximum isometric strength measurement for the muscles (up to 28) that are important for this sport. Especially the trunk musculature was of a high importance. Because of the present study, general strength values are now available for all para-badminton relevant muscles/muscle groups and serve as strength training orientation values and to prevent injuries following muscle imbalances. It has been shown that the trunk musculature plays a key role. This applies not only to preventive considerations, but also badminton-specific movements

- Agonist-antagonist comparison showed high significant differences between the trunk flexion and trunk extension muscles
- Upper and lower body muscles strength ratios (dominant vs non-dominant and agonist vs antagonist) were received

Key words: *para-badminton, strength ratios, trunk*

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HOW UNFORCED ERRORS AND WINNER POINT CAN DEFINE A BADMINTON MATCH OUTCOME?

Abstract

The unforced errors (UE) and winner points (WP) are the notational analysis most used as performance indicators in badminton matches. Winner players perform significantly more WP, while loser players perform more UE. However, it is unknown how the interaction between UE and WP may influence the match outcome. The aim of this study was to calculate the probability of winning a game of badminton based on the two events, UE and WP, occurring together. All men single matches (n=56) from the 2016 Olympic Games were recorded and analysed. The binomial logistic regression was used to calculate the probability of winning a game. The game outcome was considered as dependent variable (Victory=1, Loss=0) and the frequency of UE and WP as independent variables. We found that a frequency greater than 10 WP and fewer than 5 UE present a high probability (>80%) of winning a game. On the other hand, frequencies above 9 UE and under 6 WP distance the athlete from the victory (<20%). When the number of UE becomes greater than the WP, the probability of victory decreases significantly. The results of this study provide valuable information for the decision-making of coaches and athletes during the matches.

Key words: *badminton, notational analysis, sports performance*

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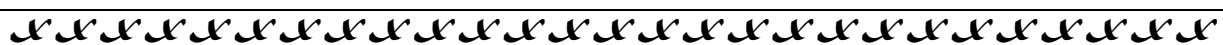
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FMS APPLICATION ON PHYSICAL CHARACTERISTIC ANALYSIS BETWEEN SINGLE AND DOUBLE PLAYERS IN BADMINTON

Abstract

Badminton competition can be played in the form of singles or doubles. The difference of forms may also influence how athletes implement different special trainings. In recent years, Functional Movement Screen (FMS) has been used to assess athlete's physical ability and risk of injury. The purpose of this study is to use FMS™ to observe the characteristic between single and double players, not only to help their coaches to set up specific training program, but also to explore possible factors that may cause injuries.19 badminton players (7 singles and 12 doubles) from National Taiwan Sport University badminton team participated in this study. All subjects performed the seven movements in FMS™, and were scored using the previously established standardized FMS™ criteria. A sport injury questionnaire was also included to understand athletes' injury history. Independent t-test was used for statistical analysis with alpha value of P <.05. The results showed that singles players were significantly higher than doubles players in hurdle steps (2.57±0.53, 2±0.43), and especially on the non-dominant side. This study also finds out that top badminton players may have better physical ability to deal with fast-paced transposition during competition. FMS™ is a screen method that can quickly find out athletes' body self-control ability. This study suggests doubles players may enhance unilateral side, especially their non-dominant leg. As for singles players, they are advised to strengthen the ability of stabilizing their body to lower the possibility of injury.

Key words: *screen, asymmetry, specific technique*

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MENTAL SKILLS IN INDIVIDUAL SPORTS THAT USE OR NOT USE RACKET SPORTS

Abstract

Coaches will try all the time to discover the best potential of their players in mental skills. Athletes use spatial orientation and mental rotations to succeed in competition. It is known that these skills are used in all sports, especially in racket sports, because of ball effect. The aim of this study was to compare these skills in individual sports that use or do not use rackets. Spatial Orientation and Mental Rotations were measured in 28 athletes divided in 4 groups (7 from table tennis; 8 from tennis; 6 from judo and 7 from fencing), the mean age was 17.6 ± .89, using CAS Battery (Miclea et al., 2009). The MANOVA results indicated significant differences between type of sport and mental rotations. Athletes from racket sports are able to recognize the ball effect from the opponent. Mental rotations score can help coaches to understand that athletes can differ in spatial skills and to develop special training for this. There were no differences between racket sports and contact sports in spatial orientation score. The meaning of this result needs further study.

Key words: *mental skills, racket sport*

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SCREENING AND DEVELOPING RACQUET SPORTS POTENTIAL WITH THE 'SPORTKOMPAS'

Abstract

Current practice in talent identification focuses on actual performance rather than potential. However, children of the same age vary considerably in biological maturation with some individuals maturing in advance or delay of their peers resulting in temporary advantages or disadvantage for sport performance. In order to better estimate the sports potential of those young athletes a validated tool 'The SportKompas' was developed. Reference scores of 179 players of the elite sport school in Flanders were included and form the fundament to a prototype of the badminton tool will be demonstrated during this presentation. The tool can evaluate individual test results, as it will be related to the biological instead of chronological age and addresses to the potential rather than actual performance. Moreover, grouping players according to their biological age offers opportunities for programs that transcend racquet sports. The sport specific training in racquet sports can be adapted to the stages of growth and maturation in order to provide the correct training stimuli. The training of pre-pubertal (< 85% of their predicted adult height) athletes will focus on neural adaptations and motor learning, while athletes in their growth spurt (between 89 and 95% of their predicted adult height) will reduce load facilitating structural changes. Finally post-pubertal athletes (> 95% of their predicted adult height) will start to train more hypertrophy-focused. The proposed development pathway aims at maximising training effect and minimising injury risk.

Key words: *racquet sports, maturation, talent identification, talent development*

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TEAM PERFORMANCE, TEAM BOND, AND COACHING DURATION ON COHESION OF YOUNG BADMINTON PLAYERS

Abstract

This investigation was designed to study the effects of team performance, team bond, and team coach's coaching duration on cohesion in young badminton players. Athletes (n=163) with successful and unsuccessful results in their team competition participated as subjects. Team bond ranged from 1 month to 5 years and time with their coaches ranged from < 6months to > 2 years. Cohesion was measured by the Youth Sport Environment Questionnaire (YSEQ). MANOVAs and ANOVAs were used to analyse 2-factor combinations of the 3 independent variables on group cohesion. Results showed statistically significant interaction between team performance and coaching duration on task cohesion but not social cohesion, $F(3,154)=3.069, p=.030$ partial $eta^2=.056$. Simple main effects analysis showed that athletes with coach of more than 2 years and 1-2 years had higher task cohesion than athletes with coach of less than 6 months only when team performance was successful. There was also a significant interaction between team performance and team bond on social cohesion but not task cohesion, $F(2,147)=4.842, p=.009$, partial $eta^2=.062$. Simple main effects analysis showed that athletes with team bond of more than 4 years had higher social cohesion than athletes with team bond of 1 year only when team performance was successful. Findings suggest that cohesion is a multifaceted construct. Specifically, the impacts of team bond and coaching duration on cohesion both depend on team performance.

Key words: *Youth Sport Environment Questionnaire, cohesiveness, competition level, badminton, racket sport*

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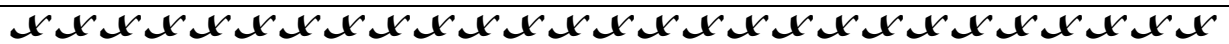
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DETERMINATION OF BADMINTON PLAYERS' DISPLACEMENT BY VIDEO ANALYSIS: RELIABILITY RESULTS OF MANUAL MEASUREMENTS

Abstract

This work presents the reliability results of the displacement of badminton players during a match determined by manual measurement of video images. Video footage of one male single match of an international competition was selected to the analysis. The position of the left and right calcaneus of both players was manually measured in a motion analysis software by 3 raters (3 times each rater) at the frames where the shuttle was in contact with the racquet. The 2D position of the player was considered as the mean position of both feet and the displacement of the player at each stroke was calculated as the distance between the initial position and the position at stroke. We found high reliability, with intraclass correlation coefficient (ICC) values between 0.9973 and 0.9996 (standard error of measurement SEM: 0.1832-0.4209) for inter-rater comparison and between 0.9987 and 0.9991 (SEM: 0.2753-0.2878) for intra-rater comparison. The results support the use of this approach to analyse the displacement of badminton players during matches. It is very suitable for coaches since it is a relevant measure, affordable and less time-consuming than other approaches based on manual tracking.

Key words: *kinematics, biomechanics, badminton*

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THE TABLE TENNIS FOREHAND STROKE TRAINING COURSE DESIGN AND PERFORMANCE ANALYSIS

Abstract

This research was mainly focused on the design of table tennis forehand stroke training course for the female beginner. The training process combines the cloud image capture technology and big data to do the performance analysis. This course design uses the multiple ball-serving training for 12 rounds forehand strokes. The serving frequency of this ball machine is 40 balls per minute. Each round needs to do 7-10 times training. The rest between rounds is 3 minutes. Each single training needs to finish 100 times strike. During the 1st-3rd rounds, the player needs to do 7-9 times training, and the total strike number is 700-900. During the 4th-12th round, the player needs to maintain 10 times training in each run, and the total strike number is 1000. To keep the quality of the ball serving, a table tennis machines is used here to reduce the deviation. The participant of this study are female students of National Taipei University of Technology. The performance analysis is based on the average hit rate. The results show the average hit rate has made significant progress with the increase in the number of training rounds. After the 5th round training, the average hit rate can be reached to 90%. It can conclude this table tennis forehand training course is effective for female college students to study the table tennis forehand stroke and posture development.

Key words: *forehand stroke, image capture technology, National Taipei University of Technology, average hit rate*

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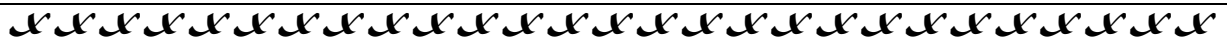
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THE RELATIONSHIP BETWEEN BALL SPEED AND BALL SPIN OF SERVE IN COLLEGIATE MALE TENNIS PLAYERS

Abstract

The purpose of this study is to clarify the relationship between ball speed and ball spin of serve in collegiate male tennis players. Participants of this study was 14 male collegiate tennis players. They were divided into two groups: high ranked players (HRP) and low ranked players (LRP). Trackman tennis radar was used to collect data of experimental matches by participants. As a result, ball speed of 1st serve of HRP (157.7±16.7km/h) was significantly faster than LRP (153.0±14.5km/h). Ball spin of 1st serve was not significantly different between HRP (2462±925rpm) and LRP (2332±823rpm). Additionally, it found that HRP occurred faults in high speed and low spin range, and LRP showed faults even in low speed and high spin range from distribution of ball speed and ball spin of 1st serve. We concluded that HRP had different technique of 1st serve in high spin range. HRP could reduce errors in 1st serve because of high spin rate.

Key words: *Trackman tennis radar, 1st serve, 2nd serve, rpm*

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ANALYSIS OF CHALLENGE REQUEST SUCCESS ACCORDING TO CONTEXTUAL VARIABLES IN ELITE BADMINTON

Abstract

Badminton has evolved into a blink-and-miss event, with powerful smashes dominating rallies. Due to the fact that the speed of smashes have increased, there are controversial decisions when the shuttlecock hits the ground during the match. Therefore, the aim of the present study was to identify the importance of challenge request effectiveness in elite badminton according to contextual-related variables. The sample was composed of 56 shuttlecock challenge requested during 20 matches (quarter-final, semi-final or final matches) from the Olympic Games (Rio de Janeiro, 2016) and the Word Badminton Championship (Glasgow, 2017). The Crosstabs-Command and the Binomial logistic regression were applied in order to identify the interactive effects on challenge success of each contextual variable (gender, requester player, next point winner, score-line, game, game interval, games in favour, challenges left per game, match-outcome and player's international experience). The main results identified that the success of a challenge is affected by the request with less efficiency when the player requests the hawk-eye (OR=0.65) and when the player that request the hawk-eye is the loser of the match (OR=0.21). The identified trends allow players to improve strategic plans that involve to select the most appropriate moment to request the calling Line Review.

Key words: *hawk-eye, badminton, performance analysis, binomial logistic regression*
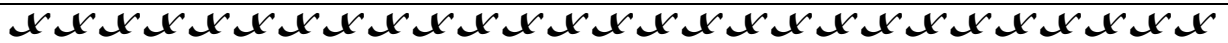
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EXPERIMENTAL STUDY ON EFFECTIVE SKILLS OF TABLE TENNIS SERVICE

Abstract

The purpose of this experimental study was to clarify effective skills of table tennis service.

Five former Japanese top players (Top Group) and nine college student players (College Group) participated as subjects. They performed three kinds of services which they considered highly effective. The order of the three kinds of services was random, and a staff member told the type of service for each time using random tables. These services were received by a table tennis coach. The stroke motion of the server and the movement of the server's racket were captured by the three-dimensional motion capture system (200 Hz). The rotation of the ball was measured by three high speed cameras (2000 Hz). The ball trajectory was captured by two high speed cameras (120 Hz).

Main results were as follows:

1) In the spin rate of ball, Top Group had a significantly higher value than College Group ($p < 0.01$).
2) In the racket tip speed at the time of impact, there was no significant difference between the 2 groups in short services ($p > 0.05$).

It is anticipated that the results will contribute to a better understanding of superior skills of table tennis service.

Key words: *motion analysis, racket tip speed, spin rate of ball, ball trajectory, top players*

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MODEL OF SOCIAL INCLUSION THROUGH SPORTS FOR PEOPLE WITH FUNCTIONAL DIVERSITY. AN INTERVENTION PROGRAM BASED ON THE PRACTICE OF BADMINTON: B4ALL

Abstract

Physical activity and sports provide multiple physical and psychological benefits to disabled people but also relevant changes regarding their social inclusion. The aim of this quasi-experimental study is to implement a sport-based inclusive program, analysing the impact on perception towards functional diversity in society and the effects on the quality of life (QoL) of people with disabilities.

This Erasmus+ funded project, supported by the Spanish Badminton Federation, has been designed on the basis of greater evidence of previous inclusive sport interventions.

Badminton, as the insertion tool selected, will provide the context for inclusive practice, using theoretical training contents, awareness events, training activities and competitions, among others.

The sample of participants will be recruited by twenty clubs and two Universities from five European countries, according to the selection criteria applied.

Outcome evaluation will rely on the gold standard *WHOQoL-bref questionnaire* and the *Attitudes Towards People with Disability scale* (ATPD). Both instruments will be applied before, just after the intervention and 7 months later on participants with and without disabilities respectively.

The implementation of this program may lead to identify significant differences in acceptance and inclusion of people with functional diversity as well as to improve their perceived quality of life.

Key words: *functional diversity, social inclusion, inclusive sports, badminton*

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THE ANALYSIS OF FUNCTIONAL MOVEMENT SCREEN ON ELITE FEMALE TENNIS PLAYER

Abstract

The most common sports injuries among tennis players are muscle strain and ligament strain. Athletes with these injuries need to be thorough exanimated in order for others to provide them instructions and treatment. In this case, Functional Movement Screen (FMS[TM]) is an important tool to identify athlete's movement limitation.

The purpose of this study is to determine the relationship and the symmetries between elite Taiwan female tennis player's score on the FMS[TM]. 14 elite female tennis players were recruited for this study. This study implemented independent-sample T-test and paired-samples T-test. Statistical analysis were conducted using SPSS version 20.0, the level of significance for all statistical test was $\alpha=0.05$.

The results showed that the lowest score among participants is 11, and the mean score is 16.64. Related researches have shown that if the score is below 14, it may exhibit higher risk. Within the seven tests of FMS[TM], participants scored 1.85 in shoulder mobility. For those scores that are below 2, it might influence their mobility or how they maintain balance. As for the five tests related to symmetries, hurdle step and shoulder mobility have showed significant asymmetries.

From the score of FMS[TM], athletes may identify deficiency in certain movements. The researcher suggests that athletes may further adjust their trainings to lower the possibility of sport injuries, thus to enhance their performance on court.

Key words: *sports injury, movement performance, injury risk*

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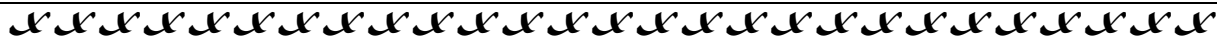*Correspondence: miguelangel.gomez.ruano@upm.es*

PERFORMANCE ANALYSIS OF MEN'S AND WOMEN'S ELITE BADMINTON PLAYERS DURING INTERNATIONAL COMPETITIONS

Abstract

The aim of the present study was to investigate the performance profile differences between men's and women's elite badminton players. The data was composed by 34 men's (n=2702 rallies) and 40 women's (n=3087 rallies) matches from international competitions (World Championship and BWF Super Series circuit) during the years 2014-2016. The variables gathered were point outcome (winner, forced-error and unforced-error when serving or receiving), serve type, match duration, rally time, rest time and strokes per rally. The comparisons between genders were done using the student t-test for quantitative variables and the Crosstab Command for categorical variables. The main results showed that women's players spend less time for rally time, rest time, number of strokes and match duration than men's players (p<0.05). In addition, the results showed that women's players commit less winners when serving and more unforced errors when reviving than men's players. Lastly, the use of serve type was different by gender with men's players mainly using the backhand short service (87.%) and women's players mainly using the forehand short, forehand long and the backhand short services (36.8%, 35.7%, and 22.2%, respectively). These findings allow the coaches to prepare the training tasks according to the gender demands in elite badminton.

Key words: *badminton, performance analysis, notational analysis, gender*

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EFFECT OF LONG RALLIES ON THE IMMEDIATE NEXT RALLY DURING ELITE MEN'S AND WOMEN'S BADMINTON LONG MATCHES

Abstract

The aim of the present study was to investigate the effect of long rallies on the immediate next rally during men's and women's elite badminton long matches (match duration >65 minutes). The data was composed by 394 and 236 rallies (10 men's and 10 women's matches, respectively) from international competitions during the year 2016. The variables gathered were point outcome (winner, forced-error and unforced-error), rally time, rest time, and frequency of strokes per rally. The comparisons between long and next points were done using the student t-test for quantitative variables and the Crosstab Command for outcome and point (long and next). The main results, for both men and women, showed larger durations for rally time and rest time, and lower frequency during long rallies than the immediate next rally (p<0.05). The results of point outcome during long and next point showed non-significant relationships for men's matches and significant relationships during women's matches (χ^2=17.905; p=0.016). In particular, the women's players performed more winners when serving during long points and committed more unforced errors when receiving during the immediate point after a long rally. The results obtained can be used by coaches to control for physical demands and unforced-errors in elite badminton.

Key words: *badminton, performance analysis, notational analysis, gender*

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BALL DATA ANALYSIS IN PROFESSIONAL MALE TENNIS PLAYERS' GROUND STROKES - FOCUSED ON DIFFERENCE OF BALL PLACEMENT AND POSITION-

Abstract

There has been a great discussion about ball placement of groundstrokes. It is broadly known that cross court shot is rally ball and down the line shot is offensive shot. However, it was not the evaluation based on objective values in which ball data as speed and ball spin rates were recorded. In recent years, it can record ball data as ball speed, spin rates, and net clearance by a new instrument. The main aim of this study was to clarify a way of how hitting by the difference of ball placement in professional players. The participants were two professional male tennis players in Japan. Two players played the game two sets. Ball data were collected by ball movement analysis system Trackman tennis radar. As the results, ball data by types of ball placement (Cross court, Center and Down the line) in player A were not significantly different on each position (Forehand: Right-Half, Left Half; Backhand). It suggests that high performance players can hit the ball accordingly without changing swing speed. Furthermore, it has a possibility that down the line shot and inside in shot are risky as it is generally said from the perspective of ball trajectory.

Key words: *ball speed, spin rates, Trackman tennis radar*
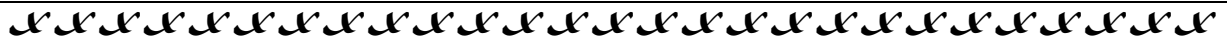
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EFFECT OF PERTURBATION-INDUCED TASKS ON EXPERT AND NOVICE TABLE TENNIS PLAYERS OVER A PERIOD OF PRACTICE

Abstract

Table tennis is a complex sport in which players need to develop tremendously in several fields to excel. Both physical and mental aspects need to be considered during the development and monitoring of players to have better idea about their potential and development. With purpose of creating an international benchmark for elite youth table tennis players a test battery was developed by the members of the Table Tennis Talent Consortium and a first pilot study was conducted in 2016 aiming to evaluate the use of the newly developed multidimensional test battery. Sixty elite youth players (♀ = 22, ♂ = 38, age 9-12 years) from various European countries were evaluated with the multidimensional test battery during the European Selection Camps that were organized by the ETTU in Otočec (Slovenia) in October of 2016 and 2017. The test battery included test items covering anthropometrics (weight, standing height, sitting height), body composition (fat mass, fat free mass, muscle mass), perceptuo-motor skills (eye hand coordination, sprint, agility), physical fitness (endurance, upper extremity strength, leg power, flexibility) and executive functions (inhibition, working memory, switching ability). In addition, a sports history questionnaire was used to map personal characteristics and the milestones of the player's table tennis career regarding among other things training and competition. Preliminary results obtained at the first steps of this longitudinal research project were presented through *basic descriptive statistic parameters*, while fundamental characteristics of measurement procedures were determined by *establishing reliability and validity* of numerous test items from which the multidimensional test battery had been consisted of.

Key words: *table tennis, multidimensional test battery, talent development, youth players*

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THE TRANSFORMING STRATEGY OF BADMINTON COACHING SYSTEM IN TAIWAN'S NATIONAL TEAM

Abstract

Purpose: This paper is to describe the status of the Taiwan's national badminton coaching system representing by the title of Chinese Taipei in policies and practice. Particularly, Taiwan has had the several world top 10 players since 2016 such as Tai Tzu Ying. **Method:** Field study including observation, documentation and interview was simultaneously adapted by an accessible inner researcher as the secretary general of Chinese Taipei badminton Association from 2016 to 2017. **Findings**: The brief overview of Taiwan's geo-political, cultural, and economic situation regarding the development of its national coaching system include qualification, remuneration, recruitment, and evaluation of coaches are revealed. Five types of coaches exist in Taiwan: International, National, professional, schooling and plains people. Even though each one had been defined by the applications, roles, knowledge and sporting achievement. The current development of its national coaching system breakthroughs the tradition to allow the plains people to be the Taiwan's top woman and man single players' coaches based on these top players' practical demand.

Key words: *elite athlete, innovation, coaching, policy, sport system*

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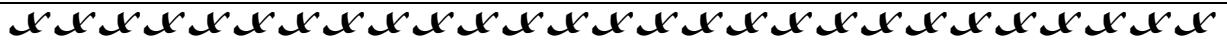
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THE RELATIONSHIP OF MORPHOLOGY, MOTOR ABILITIES AND SPECIFIC TABLE TENNIS TASKS OF YOUNG TABLE TENNIS PLAYERS' AND THEIR COMPETITIVE SUCCESS

Abstract

The aim of this research was to determine the influence of morphological characteristics, motor abilities and specific table tennis tasks on competitive success of young male Croatian table tennis players (N=60; aged 10-12 years, training experience 2.9±1.02 years). The participants were measured with 15 anthropometric measures, 24 motor tests and 6 specific table tennis tasks. After two years of measurements the competitive success was verified on points won and registered on the Croatian Table Tennis Association ranking lists for category (cadets and young cadets).

Three separately regression analysis were applied and indicators of the relationships indicated that: in morphological variables the explained variance was 32%, in motor abilities variables 46%; while in table tennis variables the explained variance was 29%. The following variables have a positive influence on the criterion variable competitive success: arm length, shoulder biacromial breadth, beep test, hand plate tapping, side to side agility, knee push ups, shooting target on the ground using a racquet, dribbling the ball using a racquet. The obtained results should be useful to trainers, providing useful information for talent identification, as well as understanding important factors for a competitive success.

Key words: *young table tennis players, morphology, motor abilities, specific table tennis tasks, success*

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TOUCHDOWN KINEMATICS AND PLANTAR PRESSURE DISTRIBUTION DURING FOREHAND AND BACKHAND IN TENNIS

Abstract

Aim of this study was to study foot movements or kinematics of touchdown during ground strokes along with amount of pressure distribution over different areas of foot on hard courts.

Ten players performed 5 forehand and 5 backhands on hard courts. Plantar pressure distribution was assessed using MOTICON OpenGo insoles. Kinematic data was collected in Sony ActionCam as100v and analysed using Dartfish video analysis software.

Touchdown pattern of leg showed the initial contact during forehand was at heel progressed to medial side of the foot till forefoot and great toe region. Backhand data showed heel to toe movement pattern with transition from medial side of the foot. Plantar pressure measurement during forehand and backhand showed similar peak pressure values on both the feet whereas mean pressure values were higher on non-dominant foot. Maximum pressure distribution area was found to be at medial side of forefoot and great toe region. Center of pressure during forehand and backhand overall was located at the second forefoot metatarsal head area and few players showed at mid foot area.

The results of this trial has important implications for the manufacturers of tennis shoe in optimizing court mobility and prevent injuries.

Key words: *tennis kinematics, plantar pressure, tennis, forehand, backhand*

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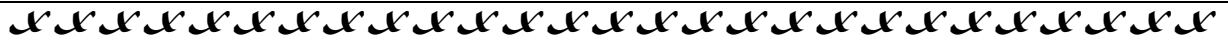
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ANALYSIS OF 2018 ITTF GERMAN OPEN GOLD MEDALISTS' PERFORMANCE IN LATE-GAME SITUATION

Abstract

Objective: In this study we analyse the gold medalists' matches in the 2018 International Table Tennis Federation (ITTF) German Open to obtain the percentage of games that entered the late-game situation (score 9-9 and after) and their percentage of winning in this situation. This is to reveal the importance of the late-game situation and the need for the athletes and coaches to prepare for this pressure-filled condition in the training program. **Methods:** We focused on the gold medalists' matches in the 2018 ITTF German Open and used statistical analysis to examine the games that reached the late-game situation. **Results:** The percentages of the gold medalists' games that entered the late-game situation were 50%, 36%, 25%, and 36% for the Men's Singles, Women's Singles, Men's Doubles, and Women's Doubles, respectively. Gold medalists' winning percentage in this condition were 83% (Men's Singles), 50% (Women's Singles), 100% (Men's Doubles), and 60% (Women's Doubles). **Conclusion:** The high late-game winning percentage ($\geq$50%) of gold medalists' performance emphasizes that at the current world-level competitions it is crucial to study the opponents' strategies and stroke patterns in the late-game situation and to devise and practice the counter moves in the training program to prepare for the competitions.

Key words: *table tennis coaching, late-game situation, technical analysis, training strategy*

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KINEMATIC ANALYSIS OF SELECTED STROKES IN BADMINTON – A PRELIMINARY STUDY

Abstract

Rule change in badminton has increased the intensity of the game and as a result it has increased the risk of injury to badminton players.

Aim of the study was to analyse joint angles of the lower extremity while performing selected strokes in badminton.

Method: The study was conducted on five university level badminton players while performing forehand and backhand net play, over the head clear and around the head drive on the badminton court. Videos were captured using Sony RX10 cameras and analysed using Kinovea software.

Results and conclusion: After the kinematic analysis, strokes have been divided into initial impact phase, maximum loading phase and recovery phase. Peak knee flexion during forehand net play was (mean±SD) $72^{\circ}\pm8.3^{\circ}$, backhand net play $68.8^{\circ}\pm6.8^{\circ}$, over the head clear $50.6^{\circ}\pm17.8^{\circ}$ and around the head drive $57.4^{\circ}\pm18.2^{\circ}$ during maximum loading phase. Peak knee valgus was noted to be 4.7° and 12° while performing overhead clear and around the head drive respectively. Average angular velocity of knee during net play was 240°/s.

Significance: Results will eventually enable coaches and health professionals to adopt injury prevention strategies while performing the strokes and train athletes accordingly.

Key words: *kinematics, biomechanics, badminton, badminton injuries*

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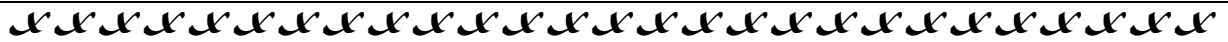
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BADMINTON SPECIFIC INJURIES: A REVIEW

Abstract

Background: Number of injuries in badminton has risen with increase in participation. Thus, there is a need to identify commonly injured structures. *Objective:* This review aims to collate the evidence on the epidemiology of the injuries resulting from the physical demands of the sport. *Methods:* Databases searched were Scopus, PubMed, Web of Science, and Ovid using relevant keywords and delimiters. The review included five prospective and fifteen retrospective studies published in English during 1979 to 2018 on players of varying caliber. *Discussion:* The rate of injuries reported in badminton are wide-ranging from 0.9 to 7.1 injuries/player/1000 hours. Majority of these injuries occur in the lower extremity (44 to 92%). The incidence rate of lower extremity injuries is higher. The injury incidence and pattern varies with ethnicity, age, gender and skill level. Another factor contributing to this variation could be the non-uniformity of the study designs and injury reporting procedures. *Conclusion:* The most frequent injuries are to the soft tissues (sprains and strains) in the ankle closely followed by knee. *Recommendations:* A universal badminton-specific injury surveillance system to monitor injury incidence, prevalence, and risk data longitudinally.

Key words: *badminton, injuries, epidemiology*

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## COMPARED STUDY OF HEALTH AND SPORT-RELATED PHYSICAL FITNESS ON COLLEGE BADMINTON AND TENNIS PLAYERS

Abstract

Understand the specific physical needs of the sport is essential in order to improve the athletic performance. Tennis and Badminton are both category in racket sport, and it also an asymmetry sport. Therefore, explore the difference between these sports may help the physical trainer to understand the difference and specific parameters relevant to the sport.

Elite Taiwan squad athlete participates in the study (tennis: 14 players, badminton: 19 players). The seven test of FMS are Deep Squat, Hurdle Step, In line Lunge, Shoulder Mobility, Active straight leg raise, Trunk Stability Push Up and Rotary Stability. Independent T- test were used to compare the score between tennis and badminton players. Paired sample test were used to compare the symmetrical between dominant and non-dominant side in both sport.

Tennis players are significantly higher than badminton players in deep squat, shoulder mobility of both sides and rotary stability of left hand right foot side. In tennis players, dominant side are significantly better than non-dominant side in in line lunge, shoulder mobility and active straight leg raise. In the symmetry comparison in both tennis and badminton sport, the study found that both of these athletes has the limitation and shows the asymmetry in dominant and non-dominant side, it give the clear sight that the player not only needs to work on the specific muscle that require for the performance, but also to train the non-dominant side of the body, in order to balance the muscle and produce the better quality of the movement.

Key words: *symmetry, FMS, fitness*

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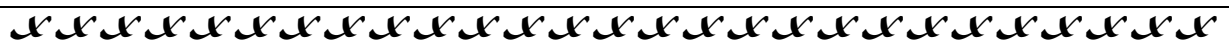
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ACCELEROMETER CAN ACCURATELY MEASURE TRAINING LOAD IN BADMINTON

Abstract

Badminton is a racket sport, with action characterized by short duration and high intensity which combined 60-70% aerobic system and 30% anaerobic system. The ratio between action time and rest time was approximated 1:2. The purpose of this study was using accelerometer to quantify training load and physical intensity. Seven male collegiate badminton athletes (age: 21.9 ±1.7 years) with training experience (4.7 ±1.6 years) were selected as participants. They wore accelerometer on non-dominant wrist for ten minutes footwork training, rapid-shots training (four-corners and smash-net), defense and playing simulation games (single and double). Data were collected and analysed based on the top ten average acceleration every minute. The results showed that the intensity changes and physical activities could be measured in different training programs. The single simulation games showed higher intensity compared to doubles simulation games. The accelerometer can identify the physical intensity and objectively assess the physiological conditions which can provide feasible information for coaches to arrange training programs and improve the performance of the athletes.

Key words: *racket sport, accelerometer, physical intensity, training load*

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A STUDY OF DYNAMIC STRENGTH INDEX IN THAI NATIONAL BADMINTON PLAYERS: CASE PRESENTATION

Abstract

Currently, at least 27 badminton tournaments were held globally. Especially, HSBC BWF World Tour Finals, HSBC BWF World Tour Super 1000, HSBC BWF World Tour Super 750, HSBC BWF World Tour Super 500, and HSBC BWF World Tour Super 300 - each of which between 2 to 3 matches were played monthly. Therefore, sports scientists should be knowledgeable about the physical change of badminton players in response to provision of suitable training compliant with their physical fitness, their corporeal fitness will reach its highest levels in the shortest period of time due to the efficacious practice. The purpose of this study is to illustrate changes in dynamic strength index of Thai national badminton players before and after 2 competitions. Four of Thai national badminton players were recruited to be tested for dynamic strength index (DSI) by 400s force plate plus mid-thigh pull rig. Peak force during counter movement jump and Isometric mid-thigh pull were analysed by Ballistic measurement program. The finding from this study revealed that dynamic strength index of them were not significant as a between before and after (P> .05). On the other hand, the dynamic strength index of three players were increased but the other one was remain unchanged. This study suggests that training program after competition should be emphasize on strength first and then switch to power and power endurance.

Key words: *badminton, dynamic strength index, isometric mid-thigh pull, counter movement jump*

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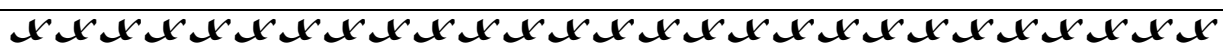
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FLUID-ELECTROLYTE BALANCE ASSOCIATED WITH BADMINTON MATCH PLAY

Abstract

The present study investigated fluid-electrolyte balance associated with badminton singles match play. Eight junior level female national badminton players played singles matches against matched opponents during two occasions. Pre and post match data on body weight; hematocrit; hemoglobin; serum sodium; serum potassium; urine specific gravity; urine sodium; and urine potassium were analysed form blood samples and urine samples taken before and immediately after matches. Sweat rate, quantity of fluid consumed during matches and the duration of matches were also calculated. The study results indicated significant decrease from pre to post match for body weight among the badminton players. Urine sodium showed significant decrease from pre to post match. No significant differences were observed form pre to post match for other variables. The percentage changes form pre to post match for body weight showed a range of 0.22 to 1.73% for the eight badminton players with an average of 0.99%. Sweat rate showed significant relationship to changes in body weight from pre to post match. Badminton players need to match fluid intake to sweat loss to avoid dehydration and electrolyte imbalance. Individualized advice and hydration protocol is vital for effective fluid and electrolyte balance for badminton players.

Key words: *body weight, sweat rate, urine sodium, badminton, fluid-electrolyte balance*

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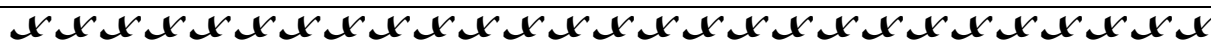[2]*Faculty of Sport Sciences, Granada University, Spain*

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GAME ANALYSIS OF WHEELCHAIR PARA-BADMINTON

Abstract

Para-Badminton (PBd) is a version of Badminton adapted for people with physical disabilities. It has a bright future and will make it's a Paralympic debut in 2020. The main purpose of this abstract is to characterize PBd matches from the WH1 category, in relation to aspects of the game such as; game time, strokes quantification, finalization points (winning points, unforced errors and forced errors) and area of the court where the shuttle landed (winners). Ten games from Men's single category, selected for accessibility, were filmed in 11th PBd World Championship (2017). A total of 66.8 (±15.53) points/game were contested. Of these, 37.5 were finished through unforced errors, 22.7 with winning points and 6.6 with forced errors. The average game time was 1780 seconds (±575.05) and the average hit on the shuttle was 552 (±197.35). The most executed strokes were: Clear (40.61%), Lob (17.78%), Drop (14.86%), Service (12.92%), Net-Shot (10.78%), Smash (2.59%) and Drive (0.46%). The most effective stroke for the winning point was the Smash (9.70%) and the region of court that most winning points were obtained was at the front (57.27%). The characterization of PBd games is fundamental for understanding the dynamics of the game and can be useful in constructing a suitable coaching/training program, in addition to providing appropriate tactical advice during games.

Key words: *Paralympic Sport, Para-Badminton, physical disability*

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DIFFERENCES IN SINGLE BADMINTON PLAYER PROFILE BETWEEN LONDON 2012 AND RIO 2016 OLYMPICS GAMES

Abstract

The purpose of the study was to compare the profile of top world level badminton single matches between the London 2012 and Rio de Janeiro 2016 Olympic Games to observe the evolution of player profile. Players were the best on the world at the time they were selected (81 males and 86 females). Age (months), height (m), mass (kg) and BMI (kg/m^2) were determined. No differences were founded in any variable. However, the mean age in male players was lower in London (324,8±37,8 months) than in Rio (337,2±48,8 months). The average mass in male players was lower in London (71,6±7,4 kilos) than in Rio (74,0±7,1 kg). The profile in female badminton player is very similar in both Olympic Games. Knowing the profile of the player throughout the Olympic Games contributes to a better knowledge of this sport discipline.

Key words: *badminton, males, females, singles profile.*

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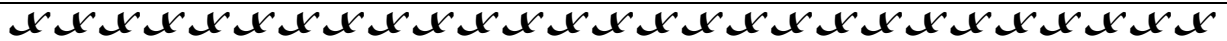[3]*Faculty of Sport Sciences, University of Granada, Spain*

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DIFFERENCES IN COMPETITION STATISTICS IN BADMINTON DOUBLES AT THE OLYMPIC GAMES

Abstract

Very little information exists about the characteristics in badminton doubles. The aim of this study was to compare the competition statistics in the three badminton doubles events (men, women and mixed). 96 badminton doubles match at the Rio 2016 Olympic Games were collected from the official website and six variables (Duration of match, longest rally (s), longest rally (strokes), average rally (s), average rally (strokes), number of shuttlecocks used were analysed. The results show that: In women doubles the longest rally and strokes are higher than in the men and mixed doubles. The same thing happens with the average rally and strokes. The number of shuttlecocks is higher in men doubles than in mixed doubles. In conclusion, it shows how the women doubles has some particular characteristics, being the men and mixed doubles more similar in these variables. Therefore, coaches working with badminton doubles players should consider these gender differences in the development of gender-tailored tactics training programs.

Key words: *notational analysis, racquet sports, performance indicators*

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ANTROPOMETRY PROFILE OF OLYMPIC SINGLES BADMINTON PLAYERS

Abstract

The aim of this study was to analyse the profile of singles elite badminton player in Olympic Games. 167 singles badminton players (81 male and 86 female) were selected. The players were the best in the world at that time. Age (months), height (m), mass (kg) and BMI (kg/m^2) were determined with their ranking position (top5 to top>46) in London 2012 and Rio de Janeiro 2016. The results shown similar characteristics in the different variables along the ranking position. In male, there is an increase in age at the top, and in RIO there are few or no participants among top-20 to top-30. There are not differences in the anthropometrics characteristics. In female, the values are very similar along the ranking and Olympic Games. In conclusion, there are no descriptive differences in the general profile of the badminton player throughout his position in the ranking.

Key words: *badminton, males, females, singles, anthropometry*

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A SCIENTOMETRIC STUDY ABOUT BADMINTON APPLIED TO SPORTS SCIENCE RESEARCH

Abstract

This study aims at learning about world publications related to Badminton research work on Sports Science. We intend to learn about (1) which areas of Sports Science are reporting about Badminton; (2) the year of the publications; (3) the publication time intervals (interstice); (4) the continent where they come from; (5) the bibliographical sources; (6) the authors; (7) the size, competition level, gender information and age the sample publication refers to. The applied method was a bibliometric and scientometric study applied to the theme "Badminton". The data was collected from the CAPES Scientific Journals Gateway, from computers with access allowed to reference information databases of the Sport Science research area, from April to August of 2016, by searching the word "Badminton" on the paper title. A Datasheet processing software was used to process and analysis. As a result, 175 papers were recovered from the SCOPUS database as published papers on 75 Research Journals, by 381 authors. The year with the largest number of publications was 2015 with 32 papers. The Journal of Sports Sciences (Taylor&Francis) appeared as the Journal with the largest number of published papers (12). Health is the Sport Science area with most publications: 43 published papers. Health, Biomechanics and Sports Training accounted for the largest scientific production on the 2013-2016 year interval, mostly produced on the European Continent. Regarding Badminton as research theme, although our research was limited to publication in English, Spanish and Portuguese languages, our findings allow us to say that research efforts are been directed to sports performance and that, after 2013, the quantity of studies increased significantly when compared to the 1991-2012 published scientific production

Key words: *badminton, review, scientometric*

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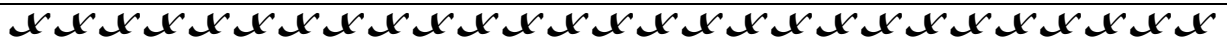
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DIFFERENCES IN STROKE PERFORMANCE STATISTICS BETWEEN MALE AND FEMALE HIGH-LEVEL TENNIS PLAYERS IN CLAY COURT SURFACE

Abstract

The aim of this study was to compare the performance of the different strokes between male and female high-level tennis players. 126 tennis singles match of Roland Garros 2015 were collected from the official website and 42 variables related winners, forced and unforced errors about ground strokes, approaches, passing shots, volleys and smashes were analysed. The results showed that: a) males got more winners with forehand and backhand drops, passing shots, volleys and smashes than females; whereas females had more winners with their backhand stroke. b) females committed more forced errors with backhand stroke, while males had more forced errors with their forehand and backhand passing shots and volleys, c) females committed more unforced errors with forehand stroke, while males have more unforced errors with their forehand and backhand passing shots and volleys. It was concluded that males had better performance with their drop and background strokes and used more the all court play as shown the results of winners, forced and unforced errors with volleys, smashes and passing shots. Based on these findings, it should be taken into account to adapt the training according to the gender of players. The accomplishment of this study is framed within the I+D+I scheme (DEP2016-76873-P), which is financed by the Ministry of Economy and Competitiveness.

Key words: *notational analysis, tennis strokes, racquet sports, performance indicators*

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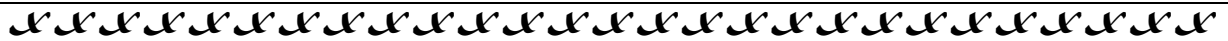[3]*Exercise Physiology Laboratory, Nikaia, Greece*

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PHYSIOLOGICAL CHARACTERISTICS OF ELITE TABLE TENNIS PLAYERS

Abstract

Little information exists so far with regards to physiological characteristics of top table tennis players. The aim of the present study was to profile the male members (n=10, age 24.0±3.8 years, body mass 77.8±8.0 kg, height 180±7 cm and body mass index 23.9±1.8 kg.m^{-2}) of the Greek national team. Body fat percentage was 16.3±3.6%, waist to hip ratio 0.82±0.04 and somatotype was endomorphic mesomorph (endomorphy 3.9±0.7, mesomorphy 4.9±0.9 and ectomorphy 2.4±1.0). The score in the sit-and-reach test was 21.2±7.9 cm, handgrip muscle strength test 48.6±8.0 kg and back-and-leg dynamometer test 149±30 kg. In a graded exercise test on a cycle ergometer, maximal oxygen uptake was 44.6±8.1 mL.kg^{-1}.min^{-1}, maximal heart rate 176±8 beats/min, maximal aerobic power 293±41W and lactate 8.9±2.9 mmol·L^{-1}. In the Wingate anaerobic test, peak power was 867±108 W, mean power 660±65 W and fatigue index 45.0±5.3%. In the force-velocity test, maximal theoretical force was 259±51 N, velocity 198±17 revolutions/min and maximal anaerobic power 1272±211 W. Based on these findings, it was suggested that top table tennis players possess moderate aerobic capacity and neuromuscular characteristics, and high anaerobic power.

Key words: *racquet sports, performance indicators*

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DIFFERENCES IN SERVE STATISTICS BETWEEN MALE AND FEMALE HIGH-LEVEL TENNIS PLAYERS IN CLAY COURT SURFACE

Abstract

Serve is a main determinant of tennis performance; however, little information exists about the variation of serve statistics by gender. The aim of this study was to compare the serve performance between male and female high-level tennis players in serve statistics. 126 tennis singles match of Roland Garros 2015 were collected from the official website and sixty variables related to first and second serve were analysed. The results showed that: a) males served faster than females; b) with first serve, males served higher percentage of serves at T zone in deuce side and at wide zone in advantage side than females, while females did more to the area of body in both sides than males; c) males won a higher percentage of points with first serve than females when they did at any zone in both sides, except at T area in Deuce side; d) females got a higher percentage of their aces at wide zone in the advantage side, whereas males got more at T zone; e) with second serve, males served a higher percentage at T zone in Deuce side and at wide zone in Advantage side than females, whereas females directed more at the body area in advantage side; f) Males won higher percentage of points with their second serve when they did at body zone in deuce side and at T zone in advantage side than females. It was concluded that according to the gender, players had different tactics patterns and performances with the serve. Therefore, coaches working with tennis players should consider these gender differences in the development of gender-tailored tactics training programs. The accomplishment of this study is framed within the I+D+I scheme (DEP2016-76873-P), which is financed by the Ministry of Economy and Competitiveness.

Key words: *notational analysis, tennis serve, racquet sports, performance indicators*

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DIFFERENCES IN COMPETITION STATISTICS BETWEEN WINNERS AND LOSERS IN MALE AND FEMALE TENNIS PLAYERS IN OLYMPIC GAMES

Abstract

The aim of this study was to examine differences in the performance indicators between winners and losers in male and female high-level tennis players. One hundred twenty-eight tennis singles matches of Summer Olympics 2012 were analysed. Data were collected from the official website of the Games and different groups of variables were analysed: serve variables (n=7), return-serve variables (n=3) and game related variables (n=5). The results showed that in both sexes winners had greater ($p<0.05$) values of second serve (%), aces, first and second serve points won (%), points won on first and second serve-return (%), break points played and break points won (%), total winners and loser with their forehand stroke, net points won (%) and maximum serve velocity. Furthermore, losers committed more doubles faults than winners, and in male category more unforced errors, whereas female winners get more winners with her backhand stroke ($p<0.05$). Performance indicators according to the result of the match predicted that break points won, first serve points won (%) and first serve-return points won (%) make the difference in male category (SC = .434; SC = .340; SC = .327), while in female category it is the break points won (SC = -.372). Therefore, coaches working with tennis players should consider the variation of the competition statistics by gender. The accomplishment of this study is framed within the I+D+I scheme (DEP2016-76873-P), which is financed by the Ministry of Economy and Competitiveness.

Key words: *notational analysis, match analysis, racquet sports, performance indicators*

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THE BALL SPEED AND THE BALL SPIN CREATED BY GROUND STROKES DURING THE RALLIES IN AN ACTUAL TENNIS MATCH

Abstract

The purpose of this study was to analyse the interaction of ball speed and ball spin of the preceding stroke on both characteristics of the following stroke during a baseline rally of a singles tennis match. Methods: Trackman tennis radar (Trackman Inc.) was used to collect the data. We installed two Trackman tennis radar systems on both side of tennis court and examined the impact of the player's stroke (speed and spin) on the respective characteristics of the following opponent's stroke. We analysed 1047 stroke combinations in 699 rallies from five players in three challenger tournament single matches (ATP world rankings ranged from 136 to 200). The obtained data were classified into four types based on the average value of the ball speed and the ball spin; (1): balls with a high speed and a high spin rate, (2): balls with a high speed and a low spin rate, (3): balls with a low speed and a high spin rate and (4): balls with a low speed and a low spin rate. Results: The data analysis shows that if one player's stroke was (1) or (2), the next return on forehand had a tendency to become (4). Also, in either case of one player's stroke was (1) to (4), the next return on backhand tended to be average value of the ball speed and the ball spin. We concluded that forehand changes with ball speed of the previous stroke, but backhand does not change with ball speed and ball spin of the previous stroke.

Key words: *ground stroke, ball speed, spin rates, Trackman tennis radar*

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PLANTAR PRESSURE DISTRIBUTION DURING LUNGE AND LANDING IN BADMINTON

Abstract

Background: Net play and Overhead strokes are two strokes primarily responsible for a large number overuse injuries on the racket hand side and acute injuries in non-racket hand side respectively. **Objective**: To investigate plantar pressure and its distribution during the maneuvers of lunge and landing during simulated game play. **Methods**: Four university level badminton players performed net-play on both forehand and backhand sides and overhead clear. To simulate match play, players were made to play strokes on a diametrically opposite direction before the selected strokes. Plantar pressures were recorded using Moticon OpenGo and analysed through Moticon OpenGo Science. **Results and Interpretation**: Peak plantar pressure was found to be higher during backhand net play as compared to forehand net play. The highest pressures were recorded at the ball of the great toe (average of 9.75 N/cm^2) and the lateral art of the hind foot (12.5 N/cm^2). Peak pressure during overhead clear on the non-racket hand side was 14.5 N/cm^2. This was noted at the ball of the great toe and the region proximal to the medial longitudinal arch.

Key words: *plantar pressure, badminton, net play, overhead clear*

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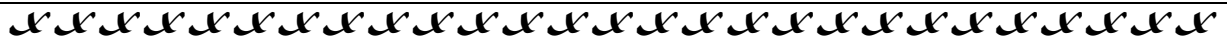
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RELATIONSHIP BETWEEN RACKET SWING AND BALL MOVEMENT IN TENNIS FOREHAND STROKE - EXPERIMENTAL STUDY BY TWO PARTICIPANTS

Abstract

The purpose of this study was to clarify the relationship between racket swing and ball movement of tennis forehand stroke. Participants of this study were two male collegiate players (player A, B). Participants hit the ball that has been released from the ball machine in their forehand stroke. In total, 109 strokes were analysed in this study (Player A: 46, B: 63). Trackman tennis radar measured ball velocity and ball spin. VICON measured velocity and angle of racket swing and angle of racket face at impact. As a result, relationship between velocity of racket head and ball velocity indicated significant positive correlation (R^2=0.629, p<.05). However, there were no significant correlation in other relationships. And there were no significant differences on ball velocity and ball spin in all participants. On the other hand, there were different characteristic in their velocity of racket swing (player A: 97.46km/h, B: 91.77km/h), angle of racket swing (player A: 10.14°, B: 15.73°) and angle of racket face at impact (player A: 79.17° B: 83.08°). Though the velocity and the spin rate of the balls are the same, the trajectories of the racket can be different. It is considered that those differences depend on gripping of participants.

Key words: *forehand stroke, racket swing, ball velocity, ball spin rate, trackman tennis radar*

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EXPLORING THE ROLE OF JUNIOR SUCCESS IN PREDICTING SENIOR SUCCESS - A CASE STUDY IN ELITE TABLE TENNIS

Abstract

Little is known about the extent to which junior success can be used to predict senior success. Some studies have demonstrated a minor relationship between athletes' junior success and senior success. However, these studies mainly focus on successes that athletes achieved at junior competitions. Successes that players achieved at international senior competitions but at a junior age have been relatively ignored. This study aims to explore the role that junior performances (age <19) at different levels of competitions in predicting eventual international success in elite table tennis. The sample comprised 397 international male and female table tennis players, born between 1982 and 1990, who competed in both international junior and senior competitions between 1997 and 2016. The discriminant analysis revealed that 55.3% of the early achievers (i.e., athletes who won medals in senior competition at a junior age) and 36.7% of the junior medalists (i.e., athletes who won medals at junior competitions) were predicted to win international senior medals. The findings demonstrate that international junior success plays a critical role in later international senior success in table tennis; still, half of the senior successful players did not win medals at international competitions at a junior age.

Key words: *table tennis, talent identification and development, junior performance, elite success*

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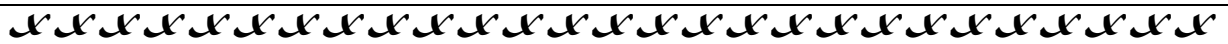
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A PROSPECTIVE STUDY ON SKELETAL MASS AND ANTHROPOMETRIC SCAN IN ASIAN YOUNG ADULT ATHLETES AND NON-ATHLETES: RELATIONSHIPS WITH HIGH IMPACT SPORTS

Abstract

Objective: The aim of this study was to compare the total and regional sites of body compositions, bone health (aBMD, BMC & BA), and anthropometric measurements between high impact and non-impact athletes, having as reference a non-athletic control group. **Methods:** A total of 44 young adults volunteered for this study. Out of this group, 21 participants represented high impact sports, which includes floorball (n = 6), table-tennis (n = 4), soccer (n = 4), tchoukball (n = 3), badminton (n = 2), and athletics (n = 2), while 10 participants represented non-impact sports, which includes aquatics (n = 7) and water-polo (n = 3). There were 13 untrained participants that represent the control group. The upper and lower limbs girth and length measurements of participants were measured by a 3D body scanner and the body composition and bone health of participants was measured by a dual-energy x-ray absorptiometry (DEXA) machine. **Results:** Athletes have lower fat percentage, fat mass, and greater in lean body mass (total, upper and lower body) when compared to control group (p ≤ 0.05). Non-impact athletes had a greater tissue mass than control group (p ≤ 0.05). High impact athletes have greater aBMD than non-impact athletes for total body(p ≤ 0.05). Between high impact athletes and control group, all areas of interest (total, upper and lower body) for aBMD and BMC were significantly different between the two groups (p ≤ 0.05). The upper body aBMD and BMC of non-impact athletes are significantly higher to control group participants (p ≤ 0.05). Non-impact athletes have higher upper limb girth and length measurements compared to the other two groups. **Conclusion:** Difference in body composition, bone health, and anthropometric measurements possibly due to the mechanical impact-load imposed by type of sports specific practices.

Key words: *body composition, bone mineral density, fat free mass, impact sports*

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SHOT OUTCOME AS A FUNCTION OF IMPACT LOCATION AND RACKET KINEMATICS IN THE BADMINTON JUMP SMASH

Abstract

Three-dimensional kinematic data of racket and shuttlecock were recorded for 297 individual jump smashes performed by fourteen badminton players (8 male; 6 female) at the 2016 All England Championships and the 2017 World Championships. The racket angle and racket head speed at impact, as well as impact location of the shuttlecock on the racket face, were determined and assessed against the resultant instantaneous post-impact shuttlecock speed and measures of post-impact shuttlecock direction. The combination of impact location and racket head speed explained 89% of observed variation in post-impact shuttlecock speed. A "sweet region" on the racket face was identified whereby impacts within 1.1 cm of the centre mediolaterally, and 3.0 cm longitudinally, caused reductions in shuttlecock speed of less than 5% of the player's maximal speed. Furthermore, impact location in both directions on the racket face explained 53% of the variation in transverse plane post-impact shuttlecock direction relative to the racket face. Racket angle in the sagittal plane at impact and longitudinal shuttlecock-racket impact location explained 72% of the variation in sagittal plane post-impact shuttlecock direction. This study provides a greater understanding of the margin for error afforded to badminton players during the jump smash.

Key words: *shuttlecock, velocity, direction*

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EFFECT OF PERTURBATION-INDUCED TASKS ON EXPERT AND NOVICE TABLE TENNIS PLAYERS OVER A PERIOD OF PRACTICE

Abstract

From a dynamical systems perspective, the critical slowing down (CSD) phenomenon, may be utilised to inform the ability of participants via their resistance to perturbation. CSD may be determined by calculating the number of trials it takes for a participant to return to the pre-perturbed state after the onset of a perturbation. The aim of this study is to examine CSD through the investigation of movement patterns via a perturbation-induced table tennis task over a period of practice. The perturbation induced was in the form of a high topspin. Experts (n=5) and beginners (n=5) were required to return a series of balls delivered by a feeding machine to a target. 3D kinematic data of the upper body was captured and digitised and results were obtained using the cluster analysis approach. Results showed that beginners displayed 10 different movement patterns as compared to experts' two. Additionally, the beginners had a decrease in total CSD from pre-test to post- and retention tests whereas the experts had a lower total CSD against all the beginner's sessions. To summarise, perturbation-induced tasks should be encouraged as a form of assessment to dichotomise skill levels and inform coaches in identifying the weaker players and provide the necessary intervention. Conversely, it may also be used to identify the better performers and higher-order training may be appropriately designed.

Key words: *critical slowing down, dynamical systems, perturbation-induced tasks*

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THE EFFECT OF ATTENTIONAL FOCUS INSTRUCTIONS IN EXECUTING A BADMINTON SERVE

Abstract

The use of verbal instructions is central in the teaching a skill. In the motor learning literature, the use of attentional focus instructions (Wulf, 1998) highlights the benefits of utilizing an external over an internal attentional focus. While numerous studies had been undertaken to investigate multi-articular movements such as Skiing (Hong & Newell, 2006), Tennis (Lee et al., 2014), Table tennis (Wan et al, 2017) and Swimming (Komar et al., 2014), there is still a dearth of studies that investigate the impact of attentional focus instructions on skills acquisition. Using 3D kinematics and cluster analysis approach, this study investigated the effects of attentional focus instructions on a badminton serve performed by experts. The results from this study revealed no statistically significant differences in performance scores across the different attentional focus groups. Movement cluster analysis revealed that participants in the control group who received only motivational instructions, exhibited similar movement cluster characteristics as those who received external focus cues. Additionally, participants tend to use external focus strategies as the movements are deeply ingrained within their perceptual motor landscape.

Key words: *focus of attention, manipulation check, cluster analysis*

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MESURING BALL SPEED AND HEIGHT ABOVE THE NET IN TABLE TENNIS

Abstract

Table tennis is often referred to as the game of spin and speed. However, these are not the only parameters characterising the game

In this research we concentrated on measuring the ball speed and height in the moment when the ball passes the net. These two parameters can reveal several information about the players (skill, playing type) as well as the game type (competition, training). We developed a measuring protocol for the automatic offline measurements in laboratory conditions. The protocol includes aligning the high speed camera with the net, calibrating it using the chess board pattern, and then recording the game at the rate of 1000 fps. The video processing software tracks the ball from frame to frame and records its trajectory until it leaves the camera view field. In each image the distance from the net top to the ball centre is calculated and the one most closely aligned with the net is recorded. Using the camera calibration data, the tracked ball trajectory path and the delay between images in video sequence, the ball speed is determined.

We recorded 40 sets played by players of different skills, one top European, two top national, one middle-ranked and one low-ranked national player, resulting in 3 TB of video data. We find out strong correlation between the player skills and both measured parameters. There was almost no difference in average ball height (within 1%) and slight difference in speed (within 6%) when the top European player and top national players played among each other. There was an increase in average ball height (7.17%) and decrease in speed (9.53%) when the top national player played the middle–ranked national player in comparison to top national players played between each other. When the middle-ranked player played the low-ranked player the increase in height was 29.89% and the decrease in speed was 20.37% in comparison to when he played the top national player.

Key words: *table tennis, ball speed, ball height, measurement*

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GENDER RELATED DIFFERENCES IN DEVELOPMENT OF CERTAIN MOTOR ABILITIES IN TALENTED YOUTH TABLE TENNIS PLAYERS

Abstract

Table tennis is a complex polystructural game, where a variety of motor abilities determine success. Our research stems from the assumption that these abilities, which undoubtedly play an important role in competitive level table tennis game, develop with age and training, but at different rates between genders. We applied 11 motor tests of power, flexibility, coordination, speed and endurance to a sample of 76 promising Slovenian table tennis players (two groups with average age 12.2 years and 14.8 years, respectively). The younger age group was composed of 29 boys (60.4%) and 19 girls (39.6%) and the older was composed of 17 (60.7%) boys and 11 (39.3%) girls. The data were gathered during regular testing at the Faculty of Sport in Ljubljana in the years 2014 and 2017. Gender and age differences, as well as potential gender-age interactions were tested using two-way analysis of variance.

The results provide a more complex picture than the initial assumption. In speed and power, which are central to table tennis, the results, as expected, improved with age and were on average better in boys than in girls. However, regarding flexibility, which is in general superior in the older group, the girls are on average superior to the boys. The overall improvement in coordination with age is smaller, with a notable interaction effect in the sense of marked improvement in boys and stagnation in girls. Basic endurance is the only ability that appears to decline from age 12 to age 15, whereby the trend is more pronounced in girls.

Key words: *table tennis, motor abilities, age, sex, differences*

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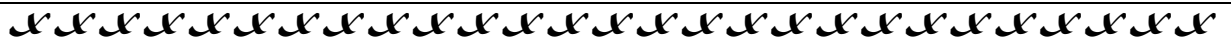
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THE INFLUENCE OF SPRAINO© ON PERFORMANCE AND SAFETY IN BADMINTON

Abstract

High shoe-surface friction is in many ways viewed as fundamental to high badminton performance, but it is also associated with an increased risk of lower-extremity injuries. Lateral ankle sprains are the most-frequent injury in badminton accounting for more than 20% of all acute injuries. An innovative preventive approach is to reduce friction along the lateral edge of the shoe using Spraino®. This allows the foot to be repositioned before an injury occurs.

Twenty-one international elite-level badminton players participated in a randomized crossover study, with the primary purpose of investigating whether Spraino® can be used in badminton without compromising performance and/or safety during a badminton-specific Speed Test. The secondary aims were to investigate lower extremity kinematics and foot positioning.

The results revealed a strong trend ($p=0.08$) towards a better performance when using Spraino® with completion times of 31.0 ± 2.2s (Spraino) and 31.5 ± 2.4s (Control). No changes were found in lower extremity kinematics and no additional horizontal movement (sliding) was shown despite initial contact on the lateral aspect of the heel.

The trend towards a faster completion time highlights, that Spraino® may be effective when used to prevent ankle sprains in badminton, without affecting performance and safety.

Key words: *badminton, performance, injury prevention, ankle sprains, friction*

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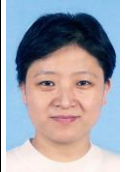
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Scientific Program

The "6th World Congress of Racket Sport Science"
May 25-26, 2018, Bangkok, Thailand
"Racket sports from a multidisciplinary perspective"
Friday, 25th May 2018

7:00-	**Registration**	
09:00 – 09:40	**Keynote lecture 1: Adrian Lees** **Title:** THE PAST, PRESENT, AND FUTURE OF RACKET SPORTS SCIENCE Chair: **David Cabello-Manrique**　　Co-Chair: **Saiphon Kongkum**	Arnoma Grand Hall
09:40 – 10:10	**Opening ceremony: Welcoming and Honorary speeches** *Khunying Patama Leeswadtrakul* **(BAT president & Chair);** *Poul-Erik Høyer,* **BWF President;** *Prof. Banchong Mahaisavariya,* **MU President**	Arnoma Grand Hall
10:10 – 10:25	**Coffee Break**	
10:25 – 11:00	**Plenary Lecture 1: Chien-Lu Tsai** **Title:** HOW BIOMECHANICS IMPROVE BADMINTON TECHNIQUES? Chair: **Weerawat Limroongreungrat**　Co-Chair: **Monchai Chottidao**	Arnoma Grand Hall
11:00 – 12:00	**Oral Session I** Chair: **Waree Widjaja**　　　　　Co-Chair: **Kornkit Chaijenkij**	Arnoma Grand Hall
11:00 – 12:00	**Oral Session II** Chair: **Weerawat Limroongreungrat**　Co-Chair: **Monchai Chottidao**	Sarocha
12:00 – 13:00	**Lunch / Poster Session / Virtual Session**	
13:00 – 13:30	**Plenary Lecture 2: Somsak Kupniratsaikul** **Title:** INJURIES IN RACKET SPORTS Chair: **Chanin Lamsam**　　　　Co-Chair: **Thun Itthipanichpong**	Arnoma Grand Hall
13:35 – 14:10	**Plenary Lecture 3: Alexander Ferrauti** **Title:** RECOVERY FOR PERFORMANCE IN RACKET SPORTS Chair: **Metta Pinthong**　　　　Co-Chair: **Alisa Nana**	Arnoma Grand Hall
14:10 – 14:40	**Poster Session / Coffee Break / Virtual Session**	
14:40 – 16:10	**Oral Session III** Chair: **Chien-Lu Tsai**　　　　Co-Chair: **Monchai Chottidao**	Arnoma Grand Hall
14:40 – 16:10	**Oral Session IV** Chair: **Adrian Lees**　　　　Co-Chair: **Chirawat Paratthakonkun**	Sarocha
16:15 – 16:55	**Plenary Lecture 4: Johan Pion** **Title:** TALENT IDENTIFICATION AND DEVELOPMENT IN BADMINTON Chair: **Amornphan Ajjimaporn**　Co-Chair: **Thun Itthipanichpong**	Arnoma Grand Hall
17:00 18:15	Workshop: GPS TRACKING FOR INDOOR ACTIVITIES **Pietro Enrico di Prampero, Christian Osgnach**	Thip-Ubol/Subongkoj/Pathummas
18:30 – 21:00	**WCRSS Cocktail reception**	Arnoma Grand Hall

Scientific Program

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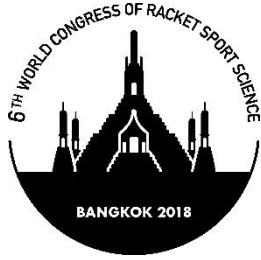|		
08.30 – 09.00	**Panel Discussion: Scientific Approaches in Racket Sports (BWF, ITF, ITTF)** Moderator: **Adrian Lees**	Arnoma Grand Hall
09:05 – 09:50	**Keynote lecture 2: Alexander Ferrauti** **Title:** SPECIAL INSIGHT INTO PHYSIOLOGY OF TENNIS Chair: **Miran Kondrič** Co-Chair: **Saiphon Kongkum**	Arnoma Grand Hall
09:50 – 10:10	**Poster Session / Coffee Break**	
10:10 – 10:40	**Plenary Lecture 5: Alisa Nana** **Title:** SPORTS NUTRITION FOR HIGH PERFORMANCE Chair: **Alexander Ferrauti** Co-Chair: **Chirawat Paratthakonkun**	Arnoma Grand Hall
10:45 – 12:00	**Oral Session 5** Chair: **Naruepon Vongjaturapat** Co-Chair: **Monchai Chottidao**	Arnoma Grand Hall
10:45 – 12:00	**Oral Session 6** Chair: **Waree Widjaja** Co-Chair: **Amornphan Ajjimaporn**	Sarocha
12:00 – 13:00	**Lunch / Poster Session / Virtual Session**	
13:00 – 13:30	**Plenary Lecture 6: Naruepon Vongjaturapat** **Title:** SPORT PSYCHOLOGY: THE MISSING PART OF BADMINTON PEAK PERFORMANCE Chair: **Johan Pion** Co-Chair: **Monchai Chottidao**	Arnoma Grand Hall
13:35 – 14:15	**Symposium I: Adrian Lees (UK)-Tennis, Chien-Lu Tsai (Taiwan)-Badminton** **Title:** BIOMECHANICS OF RACKET SPORTS Moderator: **Weerawat Limroongreungrat**	Arnoma Grand Hall
14:15 – 14:30	**Closing ceremony**	
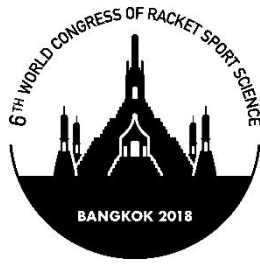
Oral Presentations

The "6th World Congress of Racket Sport Science"
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"Racket sports from a multidisciplinary perspective"

Friday, 25th May 2018

Oral Presentation I   **11.00 - 12.00 (Room: Arnoma Grand Hall)**
Chair: Waree Widjaja   **Co-Chair:** Kornkit Chaijenkij

O1	11:15-11:30	Acute effect of lactose-free skim milk and sport drink ingestion on post-exercise performance of collegiate badminton athletes (20) *Presenter: Marla Frances Tan Mallari*
O2	11:30-11:45	Fluid-electrolyte balance associated with badminton match play (51) *Presenter: Anil Ramachandran*
O3	11:30-11:45	FMS application on physical characteristic analysis between single and double players in badminton (27) *Presenter: Mu- Lin Tai*
O4	11:45-12:00	The analysis of functional movement screen on elite female tennis player (37) *Presenter: Kai-Lung Chang*

Oral Presentation II   **11.00 - 12.00 (Room: Sarocha)**
Chair: Weerawat Limroongreungrat   **Co-Chair:** Monchai Chottidao

O5	11:00-11:15	Biomechanical quantification of the key parameter related to the forehand overhead smash in Badminton (9) *Presenter: Gongbing Shan*
O6	11:15-11:30	Shot outcome as a function of impact location and racket kinematics in the badminton jump smash (66) *Presenter: Mark King*
O7	11:30-11:45	Accelerometer can accurately measure training load in badminton (49) *Presenter: Yi-Chih Lin*
O8	11:45-12:00	Development of biomechanical feedback training for learning badminton smash (8) *Presenter: Gongbing Shan*

Oral Presentation III 14.40 - 16.10 (Room: Arnoma Grand Hall)
Chair: Chien-Lu Tsai **Co-Chair:** Monchai Chottidao

O9	14:40-14:55	A study of dynamic strength index in Thai national badminton players: case presentation (50) *Presenter: Vorramate Prajongjai*
O10	14:55-15:10	Muscle-strength-ratios in para-badminton - with special consideration of the trunk muscles (25) *Presenter: Hanno Felder*
O11	15:10-15:25	*Nicolae Ochiana, Alexandru Mosoi* Mental skills in individual sports that use or not use racket sports *Presenter: Nicolae Ochiana*
O12	15:25-15:40	Analysis of challenge request success according to contextual variables in elite badminton (34) *Presenter: Laura Primo*
O13	15:40-15.55	Model of social inclusion through sports for people with functional diversity. An intervention program based on the practice of badminton: b4all (41) *Presenter: Andrea Gutiérrez-Suárez*
O14	15.55-16.10	The transforming strategy of badminton coaching system in Taiwan's national team (42) *Presenter: Chih-Yi Chen*

Oral Presentation IV 14.40 - 16.10 (Room: Sarocha)
Chair: Adrian Lees **Co-Chair:** Chirawat Paratthakonkun

O15	14:40-14:55	Features and Preventive Measures of Ocular Injuries Caused by Badminton (7) *Presenter: Jie Yu*
O16	14:55-15:10	The relationship between ball speed and ball spin of serve in collegiate male tennis players (33) *Presenter: Hiroo Takahashi*
O17	15:10-15:25	Ball data analysis in professional male tennis players' ground strokes -focused on difference of ball placement and position- (40) *Presenter: Shunsuke Murakami*
O18	15:25-15:40	The ball speed and the ball spin created by ground strokes during the rallies in actual tennis match (61) *Presenter: Ryogo Kashiwagi*
O19	15:40-15.55	Relationship between racket swing and ball movement in tennis forehand stroke-experimental study by two participants-(63) *Presenter: Shuhei Okamura*
O20	15.55-16.10	Comparison of competitive skills and tactic among varied double teams in soft tennis (12) *Presenter: Shih-Tsun Chang*

Oral Presentations

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Saturday, 26th May 2018

Oral Presentation V   **10.45 - 12.00 (Room: Arnoma Grand Hall)**
Chair: Naruepon Vongjaturapat   **Co-Chair:** Monchai Chottidao

O21	10:45-11:10	A scientometric study about badminton applied to sports science research (56) *Presenter: David Cabello-Manrique*
O22	11:00-11:15	Screening and developing racquet sports potential with the 'SportKompas' (29) *Presenter: Johan Pion*
O23	11:15-11:30	The influence of Spraino© on performance and safety in badminton (73) *Presenter: Filip Gertz Lysdal*
O24	11:30-11:45	A coaches' perspective on the contribution of anthropometric measures, physical performance, and motor coordination tests in table tennis, tennis, and badminton (13) *Presenter: Kamasha Robertson*
O25	11:45-12:00	Exploring the Role of Junior Success in Predicting Senior Success (64) *Presenter: Li Pingwei*

Oral Presentation VI   **10.45 - 12.00 (Room: Sarocha)**
Chair: Waree Widjaja   **Co-Chair:** Amornphan Ajjimaporn

O26	10:45-11:10	A responder analysis of the table stars @school intervention in primary school children (6-12 years) – preliminary results (14) *Presenter: Irene R. Faber*
O27	11:00-11:15	Challenge Analysis and Countermeasure of Traditional Table Tennis Training in 40 + Era (6) *Presenter: Lai Wai Ho*
O28	11:15-11:30	Effect of perturbation-induced tasks on expert and novice table tennis players over a period of practice (67) *Presenter: Wan Rizal*
O29	11:30-11:45	Compared study of health and sport-related physical fitness on college badminton and tennis players (48) *Presenter: Yi-Chun Lin*
O30	11:45-12:00	The relative age effect and biological maturity in Elite youth table tennis players – the Dutch case (23) *Presenter: Irene R. Faber*

Poster Presentations

The "6ᵗʰ World Congress of Racket Sport Science"
May 25-26, 2018, Bangkok, Thailand

"Racket sports from a multidisciplinary perspective"

Friday/Saturday, 25ᵗʰ-26ᵗʰ May 2018

Code	No.	Author Title
P1	17	*Sherif Fathy Saleh* Effects of training program using table tennis balls with various sizes on the performance level of some attack and counterattack skills of junior table tennis players *Presenter: Sherif Fathy Saleh*
P2	18	*Kiso Murakami, Shunsake Sakata, Masumi Matsuura* A qualitative examination of coping strategies in international tennis umpires *Presenter: Kiso Murakami*
P3	21	*Ming-Hua Hsu, Chia-Te Hsu, Sheng-Kuang Wu, Ying-Chih Chien* 3s theory for case analysis: tactical characteristics of two talented young table tennis players *Presenter: Ming-Hua Hsu*
P4	22	*Ming-Kun Chen, Ju-Chun Chien, Hsin-Hung Chiang* Research of health-related fitness toward university students: a case study of NCHU racket sports students in 2017 *Presenter: Ming-Kun Chen*
P5	30	*Angelita Cruz, Hyun-Duck Kim* Team performance, team bond, and coaching duration on cohesion of young badminton players *Presenter: Angelita Cruz*
P6	31	*Karine Jacon Sarro, João Guilherme Cren Chiminazzo, David Cabello-Manrique, Milton Shoiti Misuta* Determination of badminton players' displacement by video analysis: reliability results of manual measurements *Presenter: David Cabello-Manrique*
P7	36	*Karen Lima, Sergio Galan, Camila Cabral, Poliane Avares, Norma Rodrigues, Christian Cabido, Marcos Santos* Performance in vertical jump and use of elastic energy in badminton players *Presenter: Karen Lima*
P8	35	*Kazuto Yoshida, Yoichi Iino, Sho Tamaki, Yuki Inaba, Koshi Yamada* Experimental Study on Effective Skills of Table Tennis Service *Presenter: Kazuto Yosihda*
P9	32	*Chen-Chi An, Hua-Yi Hsu, Chen-Ching Ting* The table tennis forehand stroke training course design and performance analysis *Presenter: Chen-Chi An*
P10	43	*Ivana Nikolić, Miran Kondrič, Tomislav Hublin* The Relationship of Morphology, Motor Abilities and Specific Table Tennis Tasks of Young Table Tennis Players' and their Competitive Success *Presenter: Miran Kondrič*

P11	44	*Ajay Chavan, Fiddy David* Touchdown kinematics and plantar pressure distribution during forehand and backhand in tennis *Presenter: Ajay Chavan*
P12	45	*Te-Cheng Wu, Chen-Chi An, Jiann-Li Chen* Analysis of 2018 ITTF German open gold medalists' performance in late-game situation *Presenter: Te-Cheng Wu*
P13	46	*Darshan Kamalakar, Fiddy Davis* Kinematic analysis of selected strokes in badminton – a preliminary study *Presenter: Darshan Kamalakar*
P14	47	*Purva M. Gandhi, Shruti J. Shenoy, Fiddy Davis* Badminton specific injuries: a review *Presenter: Purva M. Gandhi*
P15	53	*Juan Carlos Blanca-Torres, Miran Kondrič, Ángel Iván Fernández-García, David Cabello-Manrique* Differences in single badminton player profile between London 2012 and Rio 2016 Olympics games *Presenter: David Cabello-Manrique*
P16	54	*Gema Torres-Luque, Miran Kondrič, Juan Carlos Blanca-Torres, David Cabello-Manrique* Differences in competition statistics in badminton doubles at the Olympic games *Presenter: Gema Torres-Luque*
P17	55	*Juan Carlos Blanca-Torres, David Cabello-Manrique, Ángel Iván Fernández-García, Miran Kondrič* Anthropometry profile of Olympic singles badminton players *Presenter: David Cabello-Manrique*
P18	68	*Shawn Yi-Ching Peh, Rizal Wan, Jia Yi Chow, John Komar* The effect of attentional focus instructions in executing a badminton serve *Presenter: Shawn Yi-Ching Peh*
P19	58	*Gema Torres-Luque, Ángel Iván Fernández-Garcia, Pantelis T. Nikolaidis* Physiological characteristics of elite table tennis players *Presenter: Gema Torres-Luque*
P20	59	*Ángel Iván Fernández-Garcia, Juan Carlos Blanca-Torres, Pantelis T. Nikolaidis, Gema Torres-Luque* Differences in serve statistics between male and female high-level tennis players in clay court surface *Presenter: Ángel Iván Fernández-Garcia*
P21	57	*Gema Torres-Luque, Juan Carlos Blanca-Torres, Pantelis T. Nikolaidis, Ángel Iván Fernández-Garcia* Differences in stroke performance statistics between male and female high-level tennis players in clay court surface *Presenter: Gema Torres-Luque*
P22	60	*Ángel Iván Fernández-Garcia, Juan Carlos Blanca-Torres, Pantelis T. Nikolaidis, Gema Torres-Luque* Differences in competition statistics between winners and losers in male and female tennis players in Olympic games *Presenter: Ángel Iván Fernández-Garcia*
P23	65	*Jaafar Mohd Haiyu, Goh Jordan, Ulin Nuha* A prospective study on skeletal mass and anthropometric scan in Asian young adult athletes and non-athletes: relationships with high impact sports *Presenter: Jaafar Mohd Haiyu*
P24	69	*Goran Munivrana, Irene Faber, Michael Fuchs, Miran Kondrič, Igor Jelaska, Nicolae Ochiana, Tina Matjašič* A first step to create an international benchmark for talent development in table tennis *Presenter: Goran Munivrana*

P25	**70**	*Miran Kondrič, Ivana Nikolić, Gordana Furjan-Mandić, Goran Munivrana, Nicolae Ochiana, Tina Matjašič* Gender related differences in development of certain motor abilities in talented youth table tennis players *Presenter: Miran Kondrič*
P26	**71**	*Miran Kondrič, Drago Torkar, Matej Supej, Jan Ogrin, Tina Matjašič* Measuring ball speed and height above the net in table tennis *Presenter: Miran Kondrič*
P27	**72**	*Tsung-Min Hung,Kuan-Fu Chen,Chung-Ju Huang,Tai-Ting Chen,Ting-Yu Chueh,Miran Kondrič* Difference of visuo-spatial working memory capacity in table tennis players with different levels of skill: an erp study *Presenter: Miran Kondrič*
		VIRTUAL PRESENTATIONS
V1	**38**	*Miguel-Ángel Gómez, Fernando Rivas, Luis-Miguel Ruiz* Performance analysis of men's and women's elite badminton players during international competitions *Presenter: Miguel-Ángel Gómez*
V2	**39**	*Miguel-Ángel Gómez, Fernando Rivas, Luis-Miguel Ruiz* Effect of long rallies on the immediate next rally during elite men's and women's badminton long matches *Presenter: Miguel-Ángel Gómez*
V3	**26**	*João Guilherme Cren Chiminazzo, Julia Barreira, David Cabello-Manrique* How unforced errors and winner point can define a badminton match outcome? *Presenter: João Guilherme Cren Chiminazzo*
V4	**52**	*Aline Miranda Strapasson, João Guilherme Cren Chiminazzo, David Cabello-Manrique, Roberto Rodrigues Paes* Game analysis of wheelchair para-badminton *Presenter: Aline Miranda Strapasson*
V5	**15**	*Lingjie Zhang, Gordana Furjan-Mandić* Study of shoulder posture in Beijing sport university tennis players *Presenter: Lingjie Zhang*
V6	**16**	*Lingjie Zhang, Gordana Furjan-Mandić* Sports injury investigation and risk assessment of national female tennis players *Presenter: Lingjie Zhang*
V7	**62**	*Fiddy Davis, Jarshad Thattarathil* Plantar Pressure Distribution During Lunge and Landing in Badminton *Presenter: Fiddy Davis*

Tentative Program: The "6th World Congress of Racket Sport Science" May 25-26, 2018, Bangkok, Thailand

"Racket sports from a multidisciplinary perspective"

	Time	Program	Speakers	Room
	07.00-14.30	Registration		
	08.45-09.00	VDO Presentation (Introducing Bangkok/Performance and Success of BAT)		
	09.00-09.40	Keynote I: The Past, Present, and Future of Racket Sports Science	Adrian Lees (UK) (Chair: David Cabello-Manrique, Co-Chair: Saiphon Kongkum)	Arnoma Grand Hall
	09.40-10.10	Openning ceremony: Welcoming and Honorary speeches	Khunying Patama Leeswadtrakul (IOC Member), BAT President; Poul-Erik Høyer BWF President; Prof.Banchong Mahaisavariya MU President	Arnoma Grand Hall
	10.10-10.25	Coffee Break		
	10.25-11.00	Plenary Lecture I: How Biomechanics Improve Badminton Techniques?	Chien-Lu Tsai (Taiwan) (Chair: Weerawat Limroongreungrat, Co-Chair: Monchai Chottidao)	Arnoma Grand Hall
	11.00-12.00	Oral Presentation I&II	4 papers /room	Arnoma Grand Hall and Sarocha
May 25	12.00-13.00	Lunch / Poster Session		
	13.00-13.30	Plenary lecture II (Injuries in Racket Sports)	Somsak Kupniratsaikul (Thailand) (Chair: Chanin Lamsam, Co-Chair: Thun Itthipanichpong)	Arnoma Grand Hall
	13.35-14.10	Plenary Lecture III/ Recovery for Performance in Racket Sports	Alexander Ferrauti (Germany) (Chair: Metta Pinthong, Co-Chair: Alisa Nana)	Arnoma Grand Hall
	14.10-14.40	Poster Session / Refreshment		
	14.40-16.10	Oral Presentation III & IV	6 papers /room	Arnoma Grand Hall and Sarocha
	16.15-16.55	Plenary Lecture IV: Talent identification and development in badminton	Johan Pion (Netherlands) (Chair: Amornphan Ajjimaporn, Co-Chair: Thun Itthipanichpong)	Arnoma Grand Hall
	17.00-18.15	Workshop: GPS tracking for indoor activities (Theory-Demo-Practice)	17:00 – 17:30 Pietro Enrico di Prampero (Italy) 17:30 – 18.15 Christian Osgnach (Italy)	Sarocha Thip-Ubol/Subongko j/ Pathummas
	18.30-21.00	WCRSS Cocktali reception		

May 26	08.30-09.00	Panel Discussion: Scientific Approaches in Racket Sports	BWF, ITF, ITTF (Moderator: Adrian Lees)	Arnoma Grand Hall
	09.05-09.50	Keynote II Special Insights into Physiology of Tennis	Alexander Ferrauti (Germany) (Chair: Miran Kondrič, Co-Chair: Saiphon Kongkum)	Arnoma Grand Hall
	09.50-10.10	Poster Session / Refreshment		
	10.10-10.40	Plenary Lecture V: Sports Nutrition for High Performance	Alisa Nana (Thailand) (Chair: Alex Ferrauti, Co-Chair: Chirawat Paratthakonkun)	Arnoma Grand Hall
	10.45-12.00	Oral Presentation V&VI	5 papers /room	Arnoma Grand Hall and Sarocha
	12.00-13.00	Lunch / Poster Session		
	13.00-13.30	Plenary Lecture VI: Sport psychology: The missing part of badminton peak performance	Nareupon Vongjaturapat (Thailand) (Chair: Johan Pion, Co-Chair: Monchai Chottidao)	Arnoma Grand Hall
	13.35-14.15	Symposium I [Biomechanics of racket sports]	Adrian Lees (UK)-Tennis Chien-Lu Tsai (Taiwan)- Badminton (Moderator: Weerawat Limroongreungrat)	Arnoma Grand Hall
	14.15-14.30	Closing remarks/Coffee & Refreshments		

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