

**The 8th International Table Tennis
Federation Sports Science Congress**

**The 3rd World Congress of Science and
Racket Sports**

Les Entretiens de l'INSEP

PROGRAMME

AND

ABSTRACTS

17 - 19 May 2003, INSEP, Paris, France

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Foreword

On behalf of the ITTF Sports Science Committee I am pleased to welcome all the participants to the present congress devoted to the medical and scientific aspects of racket sports.

My sincere thanks go to Prof. Adrian Lees, Chair of steering group (racket sports) in the World Commission of Sports Science, and to Mr. Didier Lehénaff, in charge of "Les Entretiens de l'INSEP", for their full support and their active collaboration in the preparation of the congress.

Over 110 abstracts coming from 24 countries were submitted and critically reviewed by the Scientific committee, which is highly encouraging for the development of research in racket sports.

I hope you will keep a good memory of this congress, and that you will find time to enjoy your stay in Paris ...

Dr. Jean-François Kahn
ITTF Sports Science Committee Chairman
and Congress organizer

Organizing Committee

Jean-François Kahn (ITTF)

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PROGRAMME OF PODIUM PRESENTATIONS

Saturday 17 May

Sincere thanks to our partners and sponsors

The International Table Tennis Federation (ITTF)

The World Commission of Sports Science (WCSS)

The French Ministry of Sports

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- BSN Medical
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PROGRAMME OF PODIUM PRESENTATIONS

Saturday 17 May

9:00 – 9:30 : opening ceremony

Morning session : Pr. Bernard Maton and Pr. Adrian Lees

9:30 – 10:00 : keynote 1 : Pr. Adrian Lees (Liverpool, UK)

What biomechanics can tell the coach about racket play

10:00 – 10:15 : J.P. Baeyens et al. (BEL), Glenohumeral arthrokinematics of two test-cases with internal impingement at the late preparatory phase

10:15 – 10:30 : Y. Kawazoe and D. Suzuki (JPN), Impact prediction between a ball and racket in terms of contact forces, contact times, restitution coefficients and the feel in table tennis

10:30 – 10:45 : M. Kondric et al. (SLO), Myoelectric and neuromuscular measures of forehand strike in table tennis executed with balls of two different sizes

10:45 – 11:00 : Y. Ushiyama et al. (JPN), A proposal to measure the spin of a ball by digital image analysis

11:00 – 11:15 : **discussion**

11:15 – 11:45 : **poster session and visit of the exhibition**

11:45 – 12:00 : Zhang Ying Qiu (CHN), Research on the comprehensive evaluation of physical fitness and training level for the excellent adolescent paddlers in China

12:00 – 12:15 : M.A.K Bawden et al. (UK), The perception of factors that contribute to world class table tennis performance : a comparison of the English and Swedish national junior squads

12:15 – 12:30 : G. Torres et al. (ESP), Functional differences between tennis and badminton in young sportsmen

12:30 – 12:45 : P. Nourbakhsh (IRI), The women attitudes toward table tennis in Iran

12:45 – 13:00 : **discussion**

13:00 – 14:00 : **lunch**

Afternoon session : Pr. Ian Maynard and Pr. Elisabeth Rosnet

14:00 – 14:30 : keynote 2 : Pr. Elisabeth Rosnet (Reims, FRA)

Sport psychology applied to racket sports

14:30 – 14:45 : M.A.K. Bawden et al. (UK), The sources of stress for junior table tennis players who attend the English national training centre

14:45 – 15:00 : L. Crognier et al. (FRA), Is anticipation in tennis related to specific knowledge ?

15:00 – 15:15 : N. James et al. (UK), The disguise and deception of an international level squash player

15:15 – 15:30 : L. Fernandez (FRA), Sports psychology: nearly 30 years on ...

15:30 – 15:45 : Y. Palut and P.G. Zanone (FRA), Tennis as a dynamical self-organizing system

15:45 – 16:00 : A. Guillot et al. (FRA), Influence of environmental context on motor imagery quality

16:00 – 16:15 : **discussion**

16:15 – 16:45 : **poster session and visit of the exhibition**

16:45 – 17:00 : C. Sève (FRA), Impact of the new scoring system on expert table tennis players' activity

17:00 – 17:15 : H. Hammer (GER), The logic behind the scoring format in table tennis

17:15 – 17:30 : Zhang Xiaopeng (CHN), A study of the standard of new table tennis service rules

17:30 – 17:45 : G. Vuckovic et al. (SLO), Differences between the winning and the losing side in a game in terms of the distance covered during squash matches

17:45 – 18:00 : G. Poizat et al. (FRA), Descriptive study of the top spin rotation and of the striking top spin of expert table tennis players

18:00 – 18:15 : Z. Djokic (YUG), Service and service return in modern top table tennis

18:15 – 18:30 : **discussion**

18:30 – 19:30 : **workshops**

21:00 : **Congress dinner**

Sunday 18 May

Morning session : Ms. Carole Sève and Pr. Joe McIntyre

8:30 – 9:00 : keynote 3 : Pr. Joe McIntyre (Paris, FRA)

Does the brain model the laws of physics ? On catching and intercepting flying objects

9:00 – 9:15 : A.J. Pearce et al. (AUS), The effectiveness of repetitive practice on the neuromuscular pathways in elite badminton athletes

9:15 – 9:30 : E. Jousselein (FRA), Is there any interest to measure metabolic parameters in racket sports ?

9:30 – 9:45 : J.R. Blackwell et al. (USA), Effect of the Type 3 (oversize) tennis ball on physiological responses and play statistics during tennis play

9:45 – 10:00 : V. Fayt et al. (FRA), Exercise intensity influence on physiological parameters and on drive execution in table tennis

10:00 – 10:15 : A. K. Ghosh (MAS), The physiological demand of 3 most popular badminton strokes

10:15 – 10:30 : O. Girard and G.P. Millet (FRA), Effect of the ground surface on the physiological and technical responses in young tennis players

10:30 – 10:45 : discussion

10:45 – 11:30 : poster session and visit of the exhibition

11:30 – 11:45 : Y. Kobayashi et al. (JPN), Dehydration and performance during prolonged, intermittent table tennis bouts at high ambient temperature

11:45 – 12:00 : B.L. Marks et al. (USA), The effect of a new sports drink on fatigue factors in competitive tennis athletes

12:00 – 12:15 : C. Dorado García et al. (ESP), The effect of tennis participation on bone mass is better retained in male than female master tennis players

12:15 – 12:30 : G. Ducher et al. (FRA), Effects of physical activity on muscular and bone tissues in dominant and non dominant forearms of tennis players

12:30 – 12:45 : J. Sanchis Moysi et al. (ESP), Strength training maintains muscle mass and improves maximal dynamic strength in professional tennis players : a study of two cases

12:45 – 13:00 : discussion

13:00 – 14:00 : lunch

Afternoon session : Dr. Babette Pluim and Mr. Mike Hughes

14:00 – 14:30 : keynote 4 : Dr. Babette Pluim (Arnhem, NED)

Injury and rehabilitation in racket sports: similarities and differences

14:30 – 14:45 : C. Palierné (FRA), Pathologies of the locomotor apparatus in table tennis

14:45 – 15:00 : J.L. Brasseur (FRA), Ultrasonography of the foot and ankle in racket sports players

15:00 – 15:15 : O. Fernez-Bertaud et al. (FRA), Surgical treatment of tennis elbow : a study of 28 patients followed for 13 years

15:15 – 15:30 : K. Ogino et al. (JPN), Usefulness of exercise therapy using racket sports in patients with heart disease

15:30 – 15:45 : J. Bady and S. Messenger (FRA), Cardiovascular follow up of young elite squash players

15:45 – 16:00 : G. Laporte (FRA), Pelota : a « racket sport » unlike any other

16:00 – 16:15 : discussion

16:15 – 17:00 : poster session and visit of the exhibition

17:00 – 17:15 : P. Unierzyski and E. Hurnik (POL), Does practising on clay affect level of motor abilities of tennis players?

17:15 – 17:30 : M. Verlinden et al. (BEL), Influence of gender and tennis court surface properties upon strategy in elite singles

17:30 – 17:45 : Z. Major and R.W. Lang (AUT), Characterization of table tennis racket sandwich rubbers

17:45 – 18:00 : C. O. Fasan (NGR), Managing the table tennis players for now and future

18:00 – 18:15 : discussion

18:15 - 19:15 : workshops

Monday 19 May

Morning session : Mr. Didier Lehénaff and Dr. Peter O'Donoghue

8:30 – 9:00 : **keynote 5 : Dr. Peter O'Donoghue (Jordanstown, UK)**

Match analysis in racket sports

9:00 – 9:15 : A. Baca and R. Baron (AUT), A process oriented approach for match analysis in table tennis

9:15 – 9:30 : A. Hohmann and Hui Zhang (GER), Performance diagnosis by mathematical simulation in table tennis

9:30 – 9:45 : M. Hughes and A. Tutton (UK), Patterns of play of elite badminton players

9:45 – 10:00 : C. Hausswirth et al. (FRA), Determination of a specific badminton test in high-level players : comparison with an incremental running field test

10:00 – 10:15 : B. Fenwick et al. (UK), Expanding normative profiles of elite squash players using momentum of winners and errors

10:15 – 10:30 : J. Wells et al. (UK), Performance profiles of elite men's squash doubles match-play

10:30 – 10:45 : **discussion**

10:45 – 11:30 : **poster session and visit of the exhibition**

11:30 – 11:45 : Xie Wei (SIN), Application of game analysis system during Thomas Cup and Uber Cup Finals 2002

11:45 – 12:00 : L. Jospin and V. Fayt (FRA), Effort administration during increasing difficulty level training exercises in table tennis

12:00 – 12:15 : A. Bund (GER), Self-regulated learning of the forehand top spin in table tennis

12:15 – 12:30 : R.C. Jackson and M. Gudgeon (UK), Anticipating serve direction : implicit sequence learning in tennis

12:30 – 12:45 : W. Bothorel (FRA), Equipment and evolutionary pedagogy in tennis

12:45 – 13:00 : **discussion**

13:00 : **closing**

Sunday 18 May

P.1.1 : Z. Djukić (YUG), Heart rate monitors in table tennis sport : physiological aspects of the heart rate during the match and training

P.1.2 : V. Fayt et al. (FRA), Table tennis ball diameter influence on precision, organization of movement and heart rate

P.1.3 : Jia Xing et al. (CHN), The research and countermeasure of energy metabolism in Chinese table tennis athletes

P.1.4 : R.A. Shephard et al. (UK), An on-court, ghosting protocol to replicate physiological demands of a competitive squash match

P.1.5 : B. W. Smith et al. (FRA), Influence of the performance level on the EMG activity of upper limbs in table tennis

P.1.6 : J. Dohy (FRA), A clinical medical follow up of women practicing a racket sport at high level

P.1.7 : Z.D. Al-Khateeb and H.A. Al-Barghouti (JOR), Measurements of table tennis ball rebound using acoustic techniques

PROGRAMME OF POSTER SESSIONS

Saturday 17 May

- P.1.1** : S. Ambrosino et al. (FRA), Muscular activity of the backhand and forehand top spins in top table tennis players: implications for physical training
- P.1.2** : J.P. Baeyens et al. (BEL), 3D intra articular kinematics of the human acromioclavicular joint : in vitro study linking kinematic data obtained by electromagnetic trackers to 3D reconstructions of the joint configurations
- P.1.3** : A. Carazo et al. (ESP), An analysis of the relationship existing between the exit angle of the shuttlecock and the impact's height of the clear, drop and smash strokes in badminton
- P.1.4** : G. Furjan-Mandic et al. (CRO), Kinematic analysis of forehand strike in table tennis executed with balls of two different sizes
- P.1.5** : Y. Kawazoe and D. Suzuki (JPN), Comparison of the 40 mm ball with the 38 mm ball impacted to the table tennis racket based on the predicted impact phenomena
- P.1.6** : Y. Kawazoe and R. Tanahashi (JPN), A comparison of the power of light weight racket and conventional weight racket with oversized heads based on the predicted tennis impact
- P.1.7** : Y. Kawazoe and R. Tanahashi (JPN), A comparison of the feel or comfort of light weight racket and conventional weight racket with oversized heads based on the predicted tennis impact
- P.1.8** : K. Yoshida et al. (JPN), Receiving technique of rotating ball (Motion of upper limb and muscular activities)
- P.1.9** : P. Dronne and G. Avanzini (FRA), Coaching in table tennis : approach in crossed self-confrontation
- P.1.10** : G. Poizat et al. (FRA), Study of the dynamics of affective states of table-tennis players during matches
- P.1.11** : Y. Pokholenchuk et al. (UKR), System of physical training of high class sportsmen in table tennis
- P.1.12** : V. Voronova. and Y. Emshanova (UKR), Emotional experience of psychotraumatic situations of top class tennis players
- P.1.13** : C. O. Fasan (NIG), Achieving objectivity in table tennis players selection
- P.1.14** : S. Guilbert (FRA), The sociological analysis of violence in two sports of rackets
- P.1.15** : Sun Qi-Lin and Liu Dong-Hua (CHN), Research on the rule of score change in the 11 score game
- P.1.16** : Shawn Sun (CAN), Scientific vs. heuristic approach : the ways table tennis game can be played ?
- P.1.17** : Tao Ye and Gu Sheng-Yi (CHN), The exploration of the three-stage law of 11 points rule
- P.1.18** : H. Zhang and A. Hohmann (GER), Table tennis after the introduction of the 40mm-ball and the 11-point format

Sunday 18 May

- P.2.1** : Z. Djokic (YUG), Heart rate monitors in table tennis sport : physiological aspects of the heart rate during the match and training
- P.2.2** : V. Fayt et al. (FRA), Table tennis ball diameter influence on precision, organization of movement and heart rate
- P.2.3** : Jin Xing et al. (CHN), The research and countermeasure of energy metabolism on Chinese table tennis athletes
- P.2.4** : R.A. Sherman et al. (UK), An on-court, ghosting protocol to replicate physiological demands of a competitive squash match
- P.2.5** : O. Skenadji et al. (FRA), Influence of the performance level on the EMG activity of upper limbs in table tennis
- P.2.6** : J. Bady (FRA), Adapted medical follow up of women practicing a racket sport at high level
- P.2.7** : Z.D. Al-Kurdi and H.A. Al-Nashash (JOR), Measurement of table tennis ball rebound using acoustic techniques

- P.2.8** : G. Ruiz Llamas and D. Cabrera Suarez (ESP), Service in tennis : power and accuracy depending on the type of racket used
- P.2.9** : M.J. Scott (USA), Spin detectable table tennis balls
- P.2.10** : Techeng Wu and Chinshu Ouyang (CHN), The optimal training techniques for players at elementary school stage
- P.2.11** : L. Crognier and F. Riou (FRA), The ancestor of racket sports is not yet dead
- P.2.12** : Z. Djokic (YUG), Basic and special physical preparation of top table tennis players
- P.2.13** : Z. Djokic (YUG), Specific interval training in table tennis
- P.2.14** : Dong Yang and Huang Biao (CHN), Study on the effects of the closed intensive training in the China national table tennis team
- P.2.15** : Liu Dong-Hua and Xu Wei (CHN), The analysis of the forehand break-through tactics of eleven points rule
- P.2.16** : Sun Qi-lin and Gu Zhi-Nong (CHN), The analysis of the table tennis tournament of eleven points rule
- P.2.17** : P. Unierzyski and A. Wieczorek (POL), Comparison of tactical solution and game patterns in finals of two Grand Slam tournaments in tennis
- P.2.18** : Liu Qing-Guang and Gu Sheng-Yi (CHN), Comparison between Chinese and foreign table tennis technical and tactical terms

Monday 19 May

- P.3.1** : Wangjie and Baikaixiang (CHN), The expert system of the ping-pong training
- P.3.2** : Wu Xiuwen et al. (CHN), Analysis and research on the skill of pen-holder using the backhand action of knife grip
- P.3.3** : Zhang Ying Qiu and Liu Feng De (CHN), The influence of no-shelter service on table tennis tactics and skills
- P.3.4** : Z. Djokic (YUG), Differences caused by changing rules during the period 1995 – 2003 (38mm vs. 40mm ball – season 2000/2001, 11-2 system of play – season 2001/2002, new service rule – season 2002/2003)
- P.3.5** : Dong Yang (CHN), The theoretical study of Chinese and foreign table tennis technique innovation
- P.3.6** : Dong Yang (CHN), Comparison of the techniques and tactics innovation between Chinese and foreign table tennis sports
- P.3.7** : Liu Gang (CHN), A probe into knife grip play with forehand inward pimped rubber and backhand outward pimped rubber in table tennis
- P.3.8** : Li Da-Zhi and Tao Ye (CHN), Comparison between Chinese and foreign table tennis technical and tactical terms
- P.3.9** : Piren-Su (CHN), Analysis of the world table tennis technique innovations in the 20th century
- P.3.10** : Qin Zhifeng and Xie Wie (CHN), The research of table tennis players' technical and tactical features in the women' World Cup 2002
- P.3.11** : Techeng Wu (CHN), A study on characteristics of table tennis
- P.3.12** : Techeng Wu (CHN) and Koumau Chen (TPE), The training experience upon table tennis team in NCTU
- P.3.13** : G. Vuckovic et al. (SLO), Monitoring of the time the players stay on the T position and comparison between the winners and losers of individual games in terms of this indicator
- P.3.14** : D. Cabrera Suarez and G. Ruiz Llamas (ESP), The reciprocal method in the teaching of badminton
- P.3.15** : Z. Djokic (YUG), Program DJ 2001 : table tennis analyses program
- P.3.16** : P. O'Donoghue (UK), The advantage of playing less sets than the opponent in the previous two rounds of Grand Slam tennis tournaments
- P.3.17** : P. O'Donoghue and A. Ballantyne (UK), The impact of speed of service in Grand Slam singles tennis

ABSTRACTS

(Listed in alphabetic order of the name of the first author)

Measurement of the surface free energy of polymer...
 J. E. McGrath and J. A. Pochan
 Faculty of Chemical Engineering, Memorial University, St. John's, Newfoundland
 Abstract: The surface free energy of a polymer is a key parameter in determining its compatibility with other materials. This paper reports on the measurement of the surface free energy of a series of polymers using the contact angle method. The results show that the surface free energy of the polymers increases with increasing molecular weight. This is attributed to the increase in the number of surface groups as the molecular weight increases.

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Measurement of table tennis ball rebound using acoustic techniques

Z.D. Al-Kurdi¹ and H.A. Al-Nashash²

¹Faculty of Physical Education, Yamouk University, Irbid-Jordan, ²School of Engineering, American University of Sharjah, U.A.E., kurdi11@hotmail.com

It is until the international federation of table tennis has formed the sports science committee few biomechanical studies have been devoted to the analysis of table tennis. Recently a number of researchers focused their work on the science of table tennis (Renfrew, 1979; Fukunage et al., 1989; Shaoñ, 1980; Huangun, 1980; Zhoughui, 1982; Lohkov and Reznikov, 1993; Schiltz 1993; Yutaka and Yoshitsugu, 1998; Toshiko et al., 2000).

Measurement of tennis ball rebound is important for both improving players' techniques and verifying the uniformity of the table upper surface. Several methods have been developed to measure and present the dynamics of the table tennis. Researchers used the conventional video camera to record the rebound of a ball. In this research, we present a portable, simple to operate electronic system for providing accurate measurement of table tennis ball rebound. It is composed of test specimen, ball release mechanism, bounce detector and a timer. It is believed that such system will be helpful for players, coaches, manufacturers and technical committees.

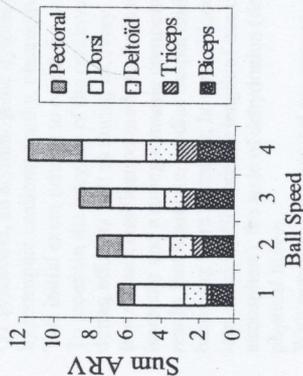
Muscular activity of the backhand and forehand top spins in top table tennis players: implications for physical training

S. Ambrosino, F. Borrani, O. Skénadjí, J.P. Micallef and G.P. Millet

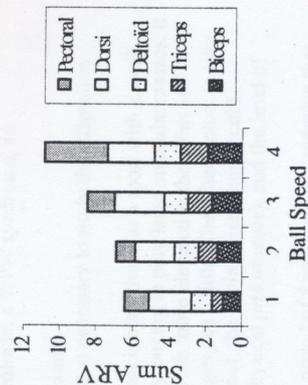
Faculty of Sports, ave. Pic Saint-Loup, Montpellier, France, ambrosino.stephane@caranmail.com

Introduction. Until now there has been no study carried out on the muscular activity of top table tennis players. But now muscular training is playing an increasingly important role in the development of the sport and likewise with the contribution of the different muscular groups involved in different shots and when using different levels of intensity. The aim of the present study was to quantify the activity of the biceps, triceps, pectoral muscle, deltoid muscle and latissimus dorsi muscle amongst top level table tennis players - both for forehand (CD) and backhand (REV) tops spins and in relation to different ball speeds. **Methods.** 7 subjects (age: 24 ± 5 years; height: 181 ± 5 cm; weight: $71,3 \pm 3,7$ kg) top level (within the French Table Tennis Federation 2346 ± 164 points) carried out 8 exercises of 30 s of backhands and forehands at 4 different ball speed levels. The acquisition of electromyographic signals from each muscle was carried out with surface electrodes using the Bagnoli (Delsys, USA) system - at a frequency of 1024 Hz. The average rectified values (ARV) were then worked out and the balls speeds measured accordingly (radar Speed Check, Canada). **Results.** The 4 ball speeds were different ($V1: 27 \pm 5$ vs 31 ± 6 ; $V2: 43 \pm 3$ vs 40 ± 7 ; $V3: 57 \pm 6$ vs 53 ± 7 ; $V4: 92 \pm 8$ vs 88 ± 11 km/h for backhand or forehand, respectively). Yet no difference was observed between backhand and forehand. The ARV of the 5 muscles studied in both forehand and backhand is shown in table 1.

EMG CD Elite



EMG REV Elite



The sum of ARV is not different to an equivalent speed between forehand and backhand. The relative participation of each muscle is different according to the different speeds used. The sum of ARV is significantly different between V1 and V4 in the pectoral muscle (CD: $0,93 \pm 0,24$ vs. $2,95 \pm 0,33$; REV: $1,28 \pm 0,47$ vs $3,48 \pm 0,34$), the triceps (CD: $0,28 \pm 0,12$ vs $1,06 \pm 0,13$; REV: $0,61 \pm 0,16$ vs $1,46 \pm 0,30$) and the biceps (CD: $1,22 \pm 1,08$ vs $2,13 \pm 0,54$) No other difference was found. The sum of ARV and the ball speeds were then correlated. : ($R^2=0,996$).

Discussion and Conclusion. The muscles studied can be said to have different functions and uses. The latissimus dorsi muscle and the deltoid muscle are mainly involved in V1. The great effort involved at this intensity consists of maintaining the arm in an appropriate position. The relative contribution of the biceps and the pectoral muscles is most important at V4, their role is to increase the power of shots played. The biceps seems to play a more significant role in high speed forehands. It is worth remembering that in table tennis no less than 82% of points are scored at the third hit of the ball; which indicates that power is indeed a key factor when it comes to performance. This in turn demonstrates the interest of power and speed related training in relation to the biceps, triceps and pectoral muscles. This demonstrates that amongst those top players who have developed the qualities of muscle control, a specific physical training aimed at an improvement in strength can indeed lead to greater ball speed.

A process oriented approach for match analysis in table tennis

A. Baca and R. Baron

*Department of Sport Science, University of Vienna, Auf der Schmelz 6, A-1150 Wien, Austria
amold.baca@univie.ac.at*

In order to identify strengths and weaknesses in the technical and tactical behaviour of racket sports players and to find out possible reasons, structure and process oriented models of the match are constructed. If process oriented models are used, the temporal evolution of the match may be described. This approach has successfully been applied to table tennis (e. g. Bogushevski et al., 1994, *Tischtennis Lehre*, 8 (1), 5-8). It has therefore been selected to analyse and improve the behaviour of players of the Austrian national and youth national team. In addition, methods from exercise physiology (acquisition of physiological parameters during training and competition) and sports psychology are applied.

In cooperation with trainers and players of the Austrian national team a model has been developed for a process oriented description of the match. In addition to gnp (shakehand / penhold), left/right handed, type of player (offensive/defensive) and rubber sheet, the model comprises information on

- the positions of the players, the bat w.r.t. the player and the ball when hitting the table
- the times when the ball is hitting the table
- strokes (forehand/backhand, topspin, block, flip, smash, etc.)
- ball speed, spin and height overnet
- service techniques
- errors and special events.

Matches are recorded by a video camera and evaluated afterwards. The possibility to record heart rates synchronized to the video has been provided. Heart rates can therefore be analysed in relation to observable actions of the match. Since the times, when the ball is hitting the table are registered by using the time code information from the digitised video, selected scenes (e. g. related actions found out by using filter functions) may be displayed sequentially with digital video.

Since only some matches have been evaluated so far (the system will be employed more intensively from January to April, 2003) only partial results are available at the time of writing. From these, it may be concluded that the method is applicable to answer questions from practice, such as

- Where should the first ball be placed ?
- How to play to attain a topspin attack possibility ?
- Which service was most successful ?
- Which return on a specific service was most successful ?

It is expected that unknown, new and potentially useful information will be found, if larger data sets are available. Methods from artificial intelligence and datamining are to be used for this purpose.

Based on the results of the analysis feedback has been and will be given to trainers and players or feedback systems will be applied in training. One aim is the quick presentation of selected meaningful video scenes. Another is to give the player immediate acoustic or optical feedback in training on the position and/or quality of the ball just played. Methods for detecting the point, where the ball hits the table automatically in real time are under development. One approach is to fix three accelerometers onto the underside of the table and to determine the hitting point from the vibration signals. From first experiments it is expected that the method will be accurate enough

Cardiovascular follow up of young elite squash players

J. Bady¹, S. Messenger² and P. Signoret³

¹A. Brillard Hospital, 94130 Nogent sur Marne, ²Henri Mondor Hospital, Department of Cardiology, 94000 Créteil, ³Fédération Française de Squash, 94100 Saint-Maur, France, messsteph@aol.com

Authors assessed the cardiovascular follow-up of 12 young athletes (8 to 13 years old) having an intensive practice of squash (French Hopes) on a period of five years. The initial objective was to assure the protection and the adaptation of the cardiac functions of the young, submitting children to a specific squash effort, and to define parameters of survey and security of the child's growth. In our set, neither pathology nor cardiac failure has been discovered, as well as no hindrance to the physiological and morphological development. This work is only a stage of the observation of the characterization of the profile of the squash player. It defines the necessary medical attention of the follow-up of the teenager and prefigure futures studies.

A standard examination includes a questioning on medical history, specifying the personal backgrounds (cardiac illness in the family), factors of risk, symptoms appearing during effort, etc.; a clinical examination with an attentive cardiac auscultation, arterial blood pressure and arterial palpation, and an ECG. To the term of this first exam, it is already possible to track down some serious cardiac abnormalities: a valvulopathy, rhythm or conduction abnormalities, a long QT syndrome, an arrhythmogenic dysplasia of the right ventricle, a WPW syndrome, an hypertrophic cardiomyopathy, obstructive or not.

This initial exam permits to orient the complementary exams.

To ascertain the integrity of the cardiovascular system, it is necessary to study the adaptation during effort as well as during recovery.

In a recent classification made in Bethesda (USA), squash is considered as a sport with a weak isometric and a strong dynamic component, that is to say putting in play large muscular masses. It results that heart rate, cardiac output and VO₂max are much more elevated as the effort is becoming more intensive; however blood pressure changes just a little. The other factors to take into consideration are the length of exercise (running time), the environment (hot or cold atmosphere), the state of dehydration (decrease of the physical performance), and the level of physical fitness.

With regard to our personal experience, spread out on a period of 5 years, we can mention that: - no child who underwent an intensive practice with competitions at the national level, and who did not present any anomaly at the beginning, didn't develop a cardiac or arterial pathology during the period of survey.

- the rare abnormalities of auscultation or on the ECG which progressively appeared during the survey, proved out to be benign, and never required a complementary examination.
- the different parameters showed a normal evolution, in line with age and the child's physical development. We can say therefore, contrarily to those that accuse squash to be too much aggressive for child's heart, that with regular controls and a suitable medical follow-up, this sport can perfectly be recommended to children.

J.P. Baeyens, P. Van Roy, E. Cattrysse and J.P. Clarijs

Dep. Experimental Anatomy, Vrije Universiteit Brussel, Brussels, Belgium
Laarbeeklaan 103 1090 Brussel, j.baeyens@pi.be

In throwing and racket sports the acromioclavicular (AC) joint can cause severe dysfunction and pain in the shoulder. Yet intra articular kinematics of the AC joint is still unclear. This presentation concerns an in vitro study using a new method linking electromagnetic kinematic tracking (Flock of Birds) and 3D reconstruction of the articular surfaces using a 3D digitizer (Microscribe)

Seven acromioclavicular (AC) specimens were taken from freshly embalmed human cadavers. The scapula was vertically fixed to a holder in such a way that the clavicle was fully free to move. 3D electromagnetic tracking sensors were fixed on the clavicle and scapula. Subsequently, each clavicle was moved through a selection of directions: pro/retraction, elevation/depression and anterior/posterior translation. The positions and rotations of each sensor were collected. A typical movement consisted of three cycles in which the joint was moved through its full range of motion. The individual sensor data were used to determine the parameters along and rotation about the estimated helical axis.

Subsequently, the positions of local anatomical landmarks and joint surface configurations were digitized with a 3D drawing stylus. These anatomical data were used for the definition of local bone or articular surface embedded co-ordinate axes. To analyze the 3D intra articular kinematics of the AC joint, the finite helical axes were related to a co-ordinate system based on the configuration of the facets of the AC joint. Furthermore, attention will be given to the shift parameter.

The clinical impact of the kinematic results will be discussed in context of the mobilization and manipulation techniques as used in manual therapy.

J.P. Baeyens, P. Van Roy, E. Cattrysse, G. Declercq and J.P. Clarijs

Dep. Experimental Anatomy, Vrije Universiteit Brussel, Brussels, Belgium
Laarbeeklaan 103, 1090 Brussel, j.baeyens@pi.be

Introduction

Without signs of anterior glenohumeral instability, throwers and racket sportsmen may present posterior shoulder pain at the end of the late preparatory phase, related to articular side rotator cuff injuries and/or posterior-superior glenoid labial injuries. This clinical presentation was labeled 'internal impingement'.

Methods

This paper compares the arthrokinematic results obtained from two test-cases suffering from posterior shoulder pain at the end of the late preparatory phase with non-symptomatic subjects. Initially, these two throwers presented instability nor impingement signs. Within two years, these two problematic shoulders had evolved into an articular side rotator cuff lesion (as confirmed by MRI) without instability signs. The experiment comprised an early stage measurement of the relationships of the glenohumeral joint in two poses. Related to the anatomical planes, the shoulder was first set in 90° abduction and 90° external rotation (pose 1). Subsequently, the late cocking position with the arm maximally externally rotated was assessed (pose 2). Helical CT-data of these discrete shoulder positions were three dimensionally reconstructed. Based on humeral and scapular sets of skeletal landmarks, rotation matrices and translation vectors were estimated and processed in a glenohumeral Euler convention and finite helical axes.

Results

The arthrokinematic data between pose 1 and pose 2 demonstrated the following differences:

For the normal shoulders, the relative and absolute contribution of intra-articular external/internal rotation ($\theta_{KG} (+/-)$): external/internal rotation component of the direction vector; $\theta_{KG} (+/-)$: external/internal rotation magnitude) was minimal ($\theta_{KG} 0.05$, -0.01 and -0.21 with $\theta_{KG} 0.27^\circ$, -0.18° and -1.67°). In contrast, a significantly different large external rotation component ($\theta_{KG} 0.83$ and 0.85) together with a significantly different large external rotation magnitude ($\theta_{KG} 28.43^\circ$ and 27.22°) were found in the symptomatic shoulders with internal impingement. In the late cocking pose, the centre point of the humeral head of both the internal impingers and the normal shoulders translated into a posteriorly localized position on the glenoid cavity (related to the center of the glenoid -7.54 and -7.73 mm, respectively -7.63 , -8.51 and -6.42 mm).

Discussion

Internal impingement has been associated in literature with excessive external rotation with or without anterior-inferior glenohumeral instability. The arthrokinematic data in this study support the impact of excessive external rotation without anterior instability in the development of an internal impingement syndrome. Preventive strategies will be discussed.

The perception of factors that contribute to world class table tennis performance : a comparison of the English and Swedish national junior squads

M.A.K Bawden¹, J. Waldner² and I.W. Maynard¹

¹Centre for Sport & Exercise Science, Sheffield Hallam University, Collegiate Crescent Campus, Sheffield, UK, m.a.bawden@shu.ac.uk, ²Swedish Table Tennis Federation.

This study investigated the perceptions of the factors that underpin world class performance in table tennis in the English and Swedish national junior squads. The initial phase of this study required the coaches of the two nations to establish the factors that they considered to be important for an individual to become world class in table tennis. The players of both nations then ranked these factors from most important to least important. The players were then required to rate themselves on each of the factors. The hierarchy of factors for the Swedish squad (n = 14) were : enjoy playing, self-confidence, motivation to reach goals, natural talent, support from parents, understanding the game, ability to practice hard, good coaching, good practice partners, ability to cope with pressure, physical fitness, good technique, tactical awareness. The hierarchy of factors for the English squad (n = 19) were : enjoy playing, motivation to reach goals, self-confidence, ability to practice hard, ability to cope with pressure, physical fitness, support from parents, understanding and reading the game, tactical awareness, natural talent, good technique, good practice partners, good coaching. The two major differences that existed between the two nations were their perceptions of ability to deal with pressure, and natural talent. The English players perceived ability to cope with pressure as being an essential factor whereas the Swedish players did not see this factor as being as important. For the Swedish players natural talent was perceived to be very important in order to become world class, however the English players did not perceive this to be a major factor. The findings are discussed with reference to cultural differences in attitude, and the perceived competencies of the two nations.

The sources of stress for junior table tennis players who attend the English national training centre

M.A.K. Bawden, B.J. Cheell and I.W. Maynard

Centre for Sport & Exercise Science, Sheffield Hallam University, Collegiate Crescent Campus, Sheffield, UK. m.a.bawden@shu.ac.uk

The sources of stress in elite athletes has been well documented in the academic literature (Jones, Swain & Cale, 1990). However, a new development in contemporary sport has been the emergence of national training centres. When attending these centres many young sports performers are required to live and train within this highly intense environment. The young athlete is required to adapt to many life changes in order to reach the top level in their sport. These adaptations often involve many extra life stressors that contribute to the pressure that athletes perceive themselves to be under, in their quest to reach their potential. The present study interviewed players (n = 20) and coaches (n = 4) at the national table tennis academy in England. The players were asked to identify the sources of stress that negatively influence their performance. The coaches were also required to identify the sources of stress that they perceived the players to be under. The interview required the players and coaches to rank the sources of stress from most stressful to least stressful. The most commonly sighted sources were then placed into an overall hierarchy of sources of stress for both players and coaches. The ten sources of stress that were rated highest for players were : the critical eye of coaches, personal pressure, the constant need to win, living at the centre, other players perceptions of their ability, parents, the need to reach goals, playing players worse than themselves, the perception of people outside the centre and lack of freedom to socialise. The ten highest rated sources of stress as perceived by the coaches were : parents, coaches, lack of social activities, the need to win, the need to improve, evaluation from peers, selection, school, living away from home and the demands of training. The findings are discussed with reference to recommendations to help young players cope with stress when living, training and competing, whilst attending a national training centre.

Effect of the Type 3 (oversize) tennis ball on physiological responses and play statistics during tennis play

J. R. Blackwell¹, E.M. Heath² and C. J. Thompson¹

¹University of San Francisco, 2130 Fulton Street, San Francisco, California 94117-1080 USA

²Utah State University, 7000 Old Main Hill, Logan, Utah 84322-7000 USA, blackwell@usfca.edu

The International Tennis Federation (ITF) has officially amended the Rules of Tennis in order to approve the use of two new types of balls in tournament play. The aim of introducing the new balls is to either speed up the game (fast-speed, Type 1 ball), or slow down the game (slow-speed, Type 3 ball), compared to the game when using the regular (medium-speed, Type 2) ball. The physics associated with the balls is predictable, and has been confirmed using the Type 3 ball (Blackwell, et al., 2002, Sports Biomechanics, 1(2), 187-191; Brody, 1987, Philadelphia: University of Philadelphia Press; Haake, et al., 2000, Sports Engineering, 3, 131-143). The effect of the Type 3 ball on the players' physiological responses, however, is in question. Anecdotal evidence suggests that senior players tend to default (quit) during match play at a higher rate than when playing with the medium-speed ball. The ITF web site, however, states players do not fatigue while using the Type 3 ball (<http://www.itftennis.com/html/rule/framesetst.html>). The purpose of this study was to investigate differences in physiological responses of tennis players, and confirm play statistics, using the Type 3, slow-speed ball compared to the regular, Type 2 ball.

Twenty skilled tennis players, assigned as opponents by skill level, participated in ten matches, each lasting one hour. Half the time was spent using the Type 3 ball and half the time they played with the regular ball. The order of the ball type was randomized. The mean heart rate for a player while playing with a particular ball was obtained from heart rate monitors (Polar Vantage NV) that collected average heart rates over 5 second time periods. Activity monitors (Stay Healthy RT3) measured motion (acceleration) levels every second with an accelerometer, and these values were averaged for the 30 minute play period. Matches were videotaped to allow for play analysis.

Heart rates while playing with the Type 3 ball were 156.8 ± 17.8 bpm (mean \pm SD) and significantly ($p < 0.05$) greater than the heart rates of 152.8 ± 17.0 bpm, measured while playing with the regular ball. Statistical significance was also demonstrated for the activity levels (arbitrary units), as Type 3 ball play resulted in 2024.8 ± 314.7 units, a higher value than the regular ball result of 1919.7 ± 267.1 units. Additional to the physiological variables, significant differences were revealed when looking at play statistics. Using the Type 3 ball, the average percentage of good, first serves, was $75.4 \pm 10.5\%$. This is higher than the average using the regular ball, which was $65.3 \pm 18.6\%$. The average number of good shots during a rally was also significantly higher while using the Type 3 ball (4.3 ± 1.1), compared to the average while using the regular ball (3.6 ± 1.0).

The development of the Type 3 ball is aimed at reducing the speed of the ball and at the same time making tennis easier to play. This ball is slightly (6%) larger than the regular ball, and the larger size causes additional drag and allows for a greater Magnus effect. This translates into more accuracy and a greater number of balls that stay in the court of play compared to the regular ball. It is logical that players' heart rates and activity levels would increase during Type 3 ball play because the rallies last longer. It is also logical that these results support anecdotal reports that players fatigue more while using the Type 3 ball compared to the regular ball. However, these results seem to contradict the ITF statement that players can play 35% longer while using the Type 3 ball.

Equipment and evolutionary pedagogy in tennis

W. Bothorel

French Tennis Federation, 2 avenue Gordon Bennett, 75016 Paris, France, wbothorel@fft.fr

This presentation aims, through an analysis of the fundamentals and main tennis play parameters, at introducing the latest evolution in tennis teaching and practise. "Evolutionary tennis" (le tennis évolutif), a pedagogy adapted to all ages and all levels, from beginners to confirmed players. Today's pedagogy and equipment used allow a teaching far more oriented towards success and "real play" situations. These principles apply in all teaching programmes developed by the French Tennis Federation : mini-tennis, the junior club, the adult tennis programme and school tennis.

Recent advances in ultrasound technology and the development of high-resolution ultrasound transducers have enabled detailed depiction of superficial musculoskeletal structures. The advantages of ultrasound includes wide availability and dynamic evaluation. The main disadvantage is the difficulty of ultrasonography, especially for foot and ankle, and diagnostic accuracy requires time, knowledge and meticulous attention to technical parameters. Ultrasound can be used to evaluate joints, ligaments, tendons, plantar fascias, fore-foot diseases and to look for foreign bodies. Power Doppler can be used to evaluate blood flow.

The standardisation of the procedure and the production of normal reference images seems to guarantee a global increase in quality of the sonographic examinations. The diagnostic and therapeutic impact is very important regarding the low cost of this technique.

Introduction

The effectiveness of self-regulation, or self-control, for learning has been demonstrated in the verbal or cognitive learning for a number of years (for an overview see Boekaerts et al., 2000, Handbook of self-regulation, San Diego a.o.: Academic Press). More recently, researchers have also begun to examine the effect of self-regulation on motor skill learning. In general, these studies show that self-regulation during the learning process can lead to better motor performance.

However, in previous studies the researchers stated which aspect of the practice situation should be self-regulated by the learner. Individual preferences have not been considered. Thus, the purpose of our study was to examine the effects of self-regulating a preferred versus non-preferred practice condition during learning the forehand top spin in table tennis. It was hypothesized that participants who can self-regulate a preferred practice condition outperform participants who have the control over a non-preferred practice condition.

Method

First, the participants (N=52) filled out a questionnaire in order to check up which practice conditions during the learning of the top spin-technique they would prefer for self-regulating and which not. The most preferred practice condition was the frequency of movement instruction; the less preferred condition was the choice of tasks during a practice session. Based on this results the subjects were randomly assigned to one of the following experimental groups: (1) Self-regulation of a preferred practice condition; (2) Self-regulation of a non-preferred practice condition; (3) Regulation of a preferred condition by the instructor; (4) Regulation of a non-preferred condition by the instructor. After a baseline test all participants completed two practice sessions, separated by a 2-day interval. Each practice session consisted of 100 trials. On the following days, the participants performed retention and transfer tests. All sessions (baseline, practice, retention, and transfer) were videotaped. The dependent measures included form (rating of experts) and accuracy (target area) of the forehand top spin.

Results

Movement accuracy: All groups demonstrated a consistent increase in the accuracy of the movement across the practice trials ($F(9,432)=7.42; p<0.01$). The main effects of self-regulation and preference were not significant. Also on the retention test there were no significant differences between the groups. On the transfer test, groups that had controlled their practice on a preferred condition (independent from self-regulation or not) had clearly higher scores than the groups that had regulated a non-preferred practice condition ($F(1,48)=4.98; p=0.03$).

Movement form: In terms of movement quality, we found across the practice phase a tendency for better performance of the self-regulating groups as compared with the groups that were regulated by the instructor ($F(1,48)=3.72; p=0.08$). Again, on the retention and transfer tests the self-regulated groups had higher form scores than the instructor-controlled groups ($F(1,48)=3.42; p<0.05$ and $F(1,48)=5.95; p<0.01$).

Discussion

Our goal in this study was to examine whether self-regulated movement learning is more effective, when it refers to a practice condition which is preferred by the learner. The results show differential effects of self-regulation and the preference of practice conditions. Altogether, the findings suggest that the benefits of self-regulated learning are not only caused by motivational processes. Rather it seems to be important to consider cognitive processes, e.g. the processing and representation of movement-related information.

The reciprocal method in the teaching of badminton

D. Cabrera Suarez and G. Ruiz Llamas

Departamento de Educación Física, Universidad de Las Palmas de Gran Canaria, Spain
mcabrera@def.ulpgc.es / gruiuz@def.ulpgc.es

This paper is basically a comparison between the use of a directive way of teaching (softened direct command) and reciprocal teaching for badminton at an elementary level.

The main objectives are: a comparison of the results in efficiency at play of students who have been taught only through softened direct command, and others who have received reciprocal teaching when learning badminton; the suggestion of alternative methods for the teaching of these racket activities; the use of a methodology which allows more participation in the teaching of badminton; noticing the effectiveness of observational papers and their use in other sport rackets.

The teaching of badminton, and of other racket activities, has traditionally used direct command exclusively, more or less softened, and this has proved efficient and there is no doubt about its quality. But the problem rises with large groups of students, because they cannot receive properly the necessary individualised information, before or after every situation, and this is an important condition for successful teaching, as Adams suggests.

This paper is the result of an attempt to find a solution to this problem. We try to get to individualise, as far as conditions allow, the teaching process and, at the same time, to involve the students from three points of view: motor, affective and cognitive.

For this we have tried to use a different and complementary way of teaching, i.e. reciprocal teaching. In this way the students were able to individualise, in some of the sessions, the information about its implementation. At the same time, they had an active participation in the process, far from just an obedient attitude.

Subjects: two groups of students (102 boys and girls together) of badminton.

Materials: one group was given specific observation sheets. A test for measuring the efficiency in the play was also given to both groups.

Methodology: One group (A) was taught only through "softened" or "modified" direct command. The other one (group B) was taught through a combination of two ways, i.e. softened direct command and reciprocal teaching. First, direct command was used to order the different types of hits and to mention usual exercises or play routines; later on, reciprocal teaching was used after three different hitting techniques during the main part of the session, and the students were given an observation sheet which they had to give back to the teacher at the end of the session. The students received from the teacher all the necessary information about the elements that had to be observed, and activities unknown to the students were never included. They were then grouped in twos on the different playing fields. Two of them performed the hits suggested in the sheet and other two observed. These functions were later alternated. Every student had a sheet and had to fill it in, giving the names of the "performers" and the "observers".

Results: group B had better results. This was the group using the observation sheets, which meant the combination of reciprocal teaching and direct command. Only in one of the items (saque alto) the results were the same for both groups.

Conclusion: we think that group B had a better understanding of the orders, which, together with directive practice, certainly made automation much easier. We also observed that the individuals belonging to group B had more resources during the performance, and made things more difficult for their opponents at play. Apart from that, and from a general point of view, we can also assure that particular group proved a better understanding, and thus a better learning, of the subject "Badminton".

An analysis of the relationship existing between the exit angle of the shuttlecock and the impact's height of the clear, drop and smash strokes in badminton.

A. Carazo¹, D. Cabello¹ and F. Rivas²

¹Faculty of Education (4/A David Cabello), University of Granada, Campus de Cartuja, s/n. 18071, Granada, Spain, dcabello@ugr.es. ²University of Amsterdam

The analysis of technical execution in badminton from a biomechanical perspective allows us to develop a precise depiction and evaluation of those techniques, which are used in overhead strokes such as the clear, the drop and the smash. The main goals of this study are: a) to design an effective methodological approach to these strokes; b) to develop a series of appropriate instrumental techniques that allows us to carry out a biomechanical analysis of the technical elements of these badminton strokes; and c) to study those biomechanical factors which will determine the efficiency of these strokes under competition conditions (Sprigings, E., et al., 1994, Journal of Biomechanics, 27(3), 245-254).

In order to analyse these strokes, we recorded two strokes of each type performed by four top-flight sportsmen under competition conditions; one of them was performed from the left side of the court while the other one was thrown from its right side. These strokes were analysed through a three-dimensional photogrammetric technique at 50 Hz.

Their analysis followed a two-fold division; on the one hand, we analysed product factors (exit angle of the shuttle) as decisive in the performance of the stroke; on the other hand, we considered process factors. By process factors we understand those variables whose modification or alteration generate changes in the product factors. They include the maximum height of the gravity centre in air phase, the vertical displacement of the gravity centre in air phase, and the height of the gravity centre at the moment impact takes place.

According to results, the exit angle of the shuttle has a significant importance in the execution of these strokes since it determines the final trajectory of the stroke and the fall area of the shuttle. The study of the difference existing between the maximum height of the gravity centre and the height of the gravity centre at the moment impact takes place shows the way players hit the shuttle in the descending phase. Therefore, we can state it doesn't exist a true vertical jump but rather a displacement in back jump due to the difference existing among the two heights; such a difference ranges from 0.04 m in the clear and 0.11 m in the smash.

The exit angle of the shuttle can serve the purpose of predicting the characteristics of the stroke the player will hit. Thus, it allows the opponent to anticipate the kind of stroke the player will perform. Finally, it would be also convenient to carry out some future research in which photogrammetric techniques and the analysis of the efficiency of strokes regarding the trajectory and the fall area of the shuttle are combined.

L. Crognier and F. Riou

UPRES EA 3596, Campus de Fougères, 97167 Pointe à Pitre, France (French West Indies)

Le Jeu de Paume, as it is called in France (Real or Royal Tennis in Britain), is usually considered to be the ancestor of racket sports (De Luze, 1933, La magnifique histoire du jeu de paume). The Renaissance was a golden age for *Le Jeu de Paume*, the favourite game of the king and his courtiers. The two most famous versions were *La Courte Paume*, which was played in enclosed court, and *La Longue Paume*, which was played on the paths surrounding castles. In this paper, we first show how its decline was contrasted by its astonishing usage in the French language. We then explain how *Le Jeu de Paume* can be used to understand and to justify the origins of the current rules of tennis, which remain mysterious.

Like other forms of entertainment, the history of *Le Jeu de Paume* explains how French society used to be organized. The places where the game was played, the instruments used to play, the rules and the accidents associated with this famous game are good indicators of social practices, habits and faults (Mehi, 1990, Les jeux au royaume de France du XIII^e siècle au début du XVI^e siècle). Moreover, *Le Jeu de Paume* was so popular during the Renaissance that the players' behaviours became incorporated into the French language. Indeed, a lot of metaphorical expressions have become part of everyday vocabulary: "qui va à la chasse perd sa place", "amuser la galerie", "tomber à pic", "rester sur le carreau", "prendre l'avantage", "paumer", "y laisser sa chemise", "prendre la balle au bond", "faire faux bond", "se renvoyer la balle", "un enfant de la balle" (Arramendy, 2000, Le jeu, la balle et nous, 164-169). *La Longue Paume* is currently only played in some areas (e.g., Picardy) and only three courts remain in activity (Bordeaux, Fontainebleau and Paris). In spite of this, *Le Jeu de Paume* appears to be well anchored in the memory of French citizens.

The history of *Le Jeu de Paume* illustrates the life cycle of games and sports. Lawn tennis was invented by Major Wingfield in 1874. This game was derived from Real Tennis and preserved the crucial idea that the playing always has a chance of catching up. However, the complicated system of chases and the asymmetry of the court were abandoned. The history of its ancestor helps to explain the terms used (the service, the game, the set, the match, the court), the rules (the net, the scoring system, two serves), the rituals (drawing lots by spinning the racket, changing ends, the handicaps for players' classification), the announcements (advantage in and advantage out), the acts of courtesy which make modern tennis what it is (Réunion des musées nationaux, 2001, Jeu des rois et des jeux de paume en France). For example, when the referee calls advantage out (*avantage dehors*) does he know that "in" (*le dedans*) refers to a large netted area behind the server called the winning gallery and that "out" (*le dehors*) was the other side of the court? Consequently, any changes to the rules may disrupt the subtle balance of the famous game. When the tie-break was introduced in 1971, the two point rule was maintained. The recent attempts to suppress the rule of advantage ("no ad") and to shorten the time of the game ("short set") could alter the spirit of *Le Jeu de Paume*. The level of resistance to these innovations proves that this game still influences the representations of tennis players.

L. Crognier¹, Y.A. Féry² and N. Veret¹

¹UPRES EA 3596, Campus de Fougères, 97167 Pointe à Pitre, France (French West Indies)

Does knowledge of tennis make it possible to play a more skilled game and to anticipate your competitor's shots? McPherson (1999, Research Quarterly for Exercise and Sport, 70(3), 233-251) showed that expert tennis players have a more refined and connected knowledge base than novices. Therefore, this knowledge may be an important component in anticipation, rather than a by-product of experience (Williams, 1995, Journal of Sport and Exercise Psychology, 17, 259-275). To test this hypothesis, we tested the ability of regional level male tennis players to anticipate shots and related their performances with their task-specific knowledge.

Two experiments were carried out at a six-month interval on an indoor tennis court with a fast surface. We studied 20 highly skilled players (mean age = 24.3 years), ranked between -30 and +15/3 in the system used by the French Tennis Federation. All participants faced the same experienced tennis player (ranked +5/6).

The first experiment consisted of a ball trajectory anticipation task using a temporal occlusion paradigm. Participants wore a pair of liquid-crystal spectacles that could be opened and closed manually by an assistant (Féry, 2001, Research Quarterly for Exercise and Sport, 72(2), 143-149). The participant's vision was occluded when the opponent launched the passing shot. The participants, in volley position, had to try to intercept a passing shot launched by the opponent in three situations that differed in terms of the participant's initiative (i.e. the capacity to impose his playing intent and therefore to reduce the opponent's response possibilities). For the lowest level of tactical initiative, the opponent delivered his passing shot directly, with no previous rally. For the highest level, the participant adopted the volley position after a rally. The appropriate half court location chosen to intercept the volley was the dependent variable (Crognier, 2002, Congress on Movement, Attention and Perception, Poitiers, 121).

In the second experiment, the participants were interviewed during friendly matches by manually operated cassette recorders. All participants were asked to answer the following question, originally developed by McPherson and Thomas (1989, Journal of Experimental Child Psychology, 48, 190-211), after each point: "What were you thinking about whilst playing that point"? A total of 16 between-point interviews were randomly selected for each participant. Knowledge was coded into units of information (concepts) and classified according to five major concept categories (goal, action, condition, execution, emotion). For example, the statement "I decided to move towards the net because the shot was short" was scored considered to be an action concept (coming to the net) plus a condition (the opponent's shot was short) with a link (because).

The results suggested that the players that were best able to anticipate were also the best able to generate more total concepts ($r = 0.43$) and more links between concepts ($r = 0.53$). It is noteworthy that these correlations between anticipatory performance and knowledge structure only occurred in situations with high levels of tactical initiative (i.e. after a rally).

Basic and special physical preparation of top table tennis players

Z. Djokic

Fruskorgorska 161, 22000 Sremska Mitrovica, Yugoslavia, djokic@eunet.yu

Physiological parameters during the play of professional table tennis players – by analyses of movements activities of top table tennis players (240 top players, during the period from 1996–2003), major characteristic of duration and intensity during the match.

Basic of fitness testing – theoretically basics and specific implementation of battery of tests in table tennis game.

Adequate testing of the table tennis players – the most common test for evaluation of motorical abilities connected for evaluation of basic and specific motorical abilities. Also, the periodization of the testing (prepare period, competing period, rest and recovery period).

Recovery time between trainings – as the one of the most important elements in programming of training activities, after the 8 years of practice work with top athletes from table tennis and sport games, there are results which can prove the right of the adequate planning and programming training.

Basic motoric abilities – characteristics, basic exercises for improvement, importance in table tennis game and training, specific exercises for table tennis players.

Strength (explosive, repetitive, static) – as a base for further development in play.

Speed – as one of dominant abilities in modern concept of table tennis game.

Endurance (aerobic) – from the aspect of basic motorical abilities.

Endurance (anaerobic) – upgrade the motoric abilities of table tennis players.

Coordination – in process of learning and automatization of strokes and movements

Precision – specifically connected with coordination.

Flexibility – importance for quality of training and play and as a protection of injuries.

Specification of the physical prepare in stead of the age category of players, cadet and junior players, young players and senior competitors.

Also, and specification of physical prepare in club conditions and in case of National Team prepare, will be presented.

Differences caused by changing rules during the period 1995 – 2003 (38mm vs. 40mm ball – season 2000/2001, 11-2 system of play – season 2001/2002, new service rule – season 2002/2003)

Z. Djokic

Fruskorgorska 161, 22000 Sremska Mitrovica, Yugoslavia, djokic@eunet.yu

Subject of this research is the structure of competitors' activities in sample of 240 top table tennis players (mostly leading World players - rank in the first 100 at ITTF Rank list) in competing seasons from 1994/95 to 2002/2003.

Competitors' activities were analyzed in 61 activities(variables), grouping in 3 systems of activities (variables):

1. System of variables for evaluation of frequency, way of realization and effective of technical and tactical elements(30 variables)

frequency of technical and tactical elements

effect of these elements

stroke placement zone

stroke realization zone

2. System of variables for evaluation of realization service stroke (and returning of service) and

effective after service stroke (and returning service)(23 variables)

realization of service stroke (type of service and service placement zone)

effect of service stroke and activity after the service

realization (type)of returning service

effect of returning stroke

3. System of variables for evaluation of movement activities (8 variables)

side and deep movements

change of forehand and backhand position

stroke in forehand/backhand position and arm swinging for forehand/backhand strokes

Research consists of the analysis of competitor's activities for all players, and from the aspect of success in play (winners and losers),

quality of players (position at ITTF Rank list) (better player, and lower ranked).

For every analyzed activity, basic statistical data, frequency data, percentage in complete activity and group of activity, as a characteristic from the aspect of success of play and quality of player, are done.

The statistical importance differences between:

Winners and losers / better and lower ranked are fortified.

The research consists of interpretation 3 part structure of competitors' activities of top table tennis players (as the results of Cluster analysis) and interpretation of the main factors of modern table tennis. The structure of analyzed players is fortified, also.

Basic aim of this research is rationalization and higher effectively of training process in table tennis. Considering this results of research, which are explaining modern concept of table tennis game, and factors which influence success of play and quality of play and players.

Heart rate monitors in table tennis sport : physiological aspects of the heart rate during the match and training

Z. Djokic

Fruskorgorska 161, 22000 Sremska Mitrovica, Yugoslavia, djokiczz@eunet.yu

Heart rate during the game and competition, and also during the training can be sign of quality of work - practice, condition of athletes - his physical status, and good sign for further planning of training process.

It is very hard to get a possibility to check this data during the match situation, especially in area of top table tennis. This methods were done on the senior Yugoslav National Team players, during the season 2002/2003, and as the Team which played this season in top form (leading position in European Super Division), this data represent value for table tennis theory which, of course, will improve a table tennis practice.

Control of heart rate during the match - graphically and with the numbers will be shown intensity and heart rate during the match. The collection data was done during the non official game, official game - national rank and international rank.

Control of heart rate during table tennis training - analyses consist more variants of table tennis training, from usual table tennis training, strictly tactical training before important matches, interval training, ... Analyses consist all time of training since beginning to the end of practice.

Control of heart rate during physical training - from warming up exercise to the stretching and relaxation exercise, and from different aim of practice - in stead of which motorical abilities is improving in which periodization.

Technical data: in this research all data have been taken with POLAR S-710 heart rate monitor with memory and all the data were analyzed by POLAR PRECISION PERFORMANCE SW 3.0 SOFTWARE.

For all data discussion and comments will be given, from the aspects of player, coach and experts.

Service and service return in modern top table tennis

Z. Djokic

Fruskorgorska 161, 22000 Sremska Mitrovica, Yugoslavia, djokiczz@eunet.yu

Importance of these activities - as the first stroke in game, there is absolutely big importance of practice and improvement of these table tennis elements. In modern table tennis service became the one of the most important technical and tactical elements in game, which realization is the important factor in electivity of play.

Differences caused by changing rules - during the period from 1994 - 2003 the importance and effect of service have been changing as a consequence of changing rules.

Differences caused by effectively factors - this factor is connected with previously, but give more specific influence of changing size of table tennis ball from 38mm to 40mm, change of rules of play - from 5 services to 2 services each and change of service rule from season 2002/2003.

Differences caused by qualitative factors - differences are systematically analyzed from the focus of service and return of service of leading world table tennis players in stead of those who are lower ranked and less successful (leading top 10-12 world players).

Differences between European and Asian players (major characteristics) - during the period 1995 - 2003, electivity and quality of service and return of service were analyzed and the major factors of differences are extracted and presented.

This all data have several aims for use. First to confirm and show the importance of the beginning strokes in table tennis (service and return of service), second to analyze most effective variants of use, and third to be a beginning of a good and rational planning of table tennis practice which is focus in making top results and achievements in table tennis sport.

Program DJ 2001 : table tennis analyses program
(Example – Final Team match of European Championships 2002 in Zagreb,
Sweden : Germany, match Jan Ove Waldner vs. Timo Boll).

Z. Djokic

Fruskorgorska 161, 22000 Sremska Mitrovica, Yugoslavia, djokicz@eunet.yu

Definitely the computers are involving as a complementary part of our lives, so use of modern computer technique and software in sport is nothing new, but after the pioneer work of Brazilian volleyball coach – and Head coach of Italian volleyball team for taking statistical data during the volleyball match – revolutionary start era of this kind of use PC which can improve chance for winning in match. Purpose - the table tennis analyses program DJ 2001 has been develop for use in serious table tennis play and training. By simple use of the video of the match, and collecting data in specialized data forms, and input in program, coach and player can see the basic statistical and visual data about recent play inmatch, as for analyzed players or his opponent.

Necessary equipment – video tape of the match (in this purpose the video must be from right position from where ball and position of player during the point and match can be seen all the time). Lists, PC – with Microsoft EXCEL program (Microsoft OFFICE package)

Collecting data – to input the data from video to the special lists, those who are doing the analyses must know the basic of table tennis stroke characteristic and tactic variants.

Processing – simple input data from list to program (to the programmed fields).

Reports – momentarily with input of data, program shows graphic of the analyses. There are two sheets – two major analyses.

1. Analyses of technical and tactical elements and
2. Analyses of service and return of service.

The program gives a coach or player basic statistic and data, very easy to read and for analyses, so that results can be the beginning of programming of training process in future period. Otherwise, there is a chance to coach see the week points of player, good points, and also to see mistake during the play in technical or tactical situation.

This is the program which every club can take and to use very easy and very cheap, as the request of modern table tennis. Before for these analyses the scientist was needed, today with basic knowledge of use of PC, these analyses can be done.

Specific interval training in table tennis

Z. Djokic

Fruskorgorska 161, 22000 Sremska Mitrovica, Yugoslavia, djokicz@eunet.yu

Today interval training is represented in the methodology of training as an integral part. Broadly speaking, every training is a form of interval training in a different scope. Periods of intensive work and rest are repeated cyclically, but the true interval training has its own regularities which need to be observed. Interval training can be defined as a method of training which includes all methods of training which are carried out on the basis of the interval principle and which demand a uniform change load and rest periods.

Interval pauses are not used in order to achieve total recuperation. The player must not be given a total rest before the next load period. Otherwise interval practice would not achieve its full effect. When talking about the functional principles of interval training related to energy consumption which may be either aerobic or anaerobic. Aerobic consumption related to combustion of glucose and fatty acids by using oxygen. Anaerobic combustion is a way of forming energy planned on oxygen debt. If a sportsman has greater possibility of forming energy based on oxygen debt, he is better prepared.

Purpose of specific interval training – development of the functional abilities of athlete's body to improve skills and all the motorical abilities important for table tennis and training.

Exercise – the exercise will be connected with improvement in area of aerobic Endurance, anaerobic endurance, Speed, Strength.

Duration – all intervals for improvement of the different ability are different in way of timing, aims and intensity.

The aim of this research is development of motorical, technical and tactical abilities in top condition as a complete part of table tennis training. There is a very specific way to get the athletes body in condition to 'consume' this specific interval training, otherwise without proper prepare this kind of practice can be dangerous for athlete (overttraining, injuries, and etc.).

Dong Yang and Liu Dong-Hua

The Physical Education Research Institute, Hai Jiao Tong University, 200030 Shanghai, China
 sjtusports@mail.sjtu.edu.cn

As we all know, table tennis is our "National Game". China table tennis team has been in prosperity for almost forty years. We have won 13 of all the 16 gold medals for the four Olympics since 1992 and 19 of the 21 gold medals for 43rd, 44th and 45th World Table Tennis Tournament. For a sports event, it is really a wonder. Especially the 27th Olympic Games, our athletes won all the four gold medals and three silver medals. In order to keep our advantages, it is indeed essential to study the effect of the closed intensive training by the national table tennis team, analysing both its advantages and disadvantages. On the basis of this study, we hope to raise some constructive suggestions for the future work so that we will be able to complete the training plans better and reach the expected effects.

Study object: the author consults about 48 coaches and athletes of China table tennis team who are called as investigation objects below

Study method: document investigation, questionnaire investigation and statistics.

Discussion and analysis

1. Our cognition of the training effects and insufficiency
 In the investigation, 76% of the investigation objects agree on the idea of two closed intensive trainings a year. It helps them not only to be adjusted to the best athletic state, but also not to affect their super league matches and A and B league matches. 90% of them think that it's best to arrange the closed intensive training before important matches. Moreover, 66% of them consider 30 days a suitable training period. In addition, some objects suggest that there should be time left for two or three closed intensive trainings after a year tournament task is finished and that the last 40 days before an important match should be divided into two stages, each 20 days, including 2 or 3 warm-up matches and a two-day holiday. And 77% think that the effects of every training can be kept for 2 or 3 months. Above all, most coaches and athletes can take a positive attitude toward the closed intensive training, and they have reached the uniform cognition on time planning, etc.

2. Methods to improve the effects of the closed intensive training.
- (1) Constant intensification of political thought.
- (2) Improve the diversification and pertinence of body training.
- (3) Improve the strong competitive ability of technological training.
- (4) Enrich the athletes' spare-time life.

Conclusion

1. As our traditional event, the closed intensive training before important matches has been conducting for many years. Although we have made great achievements, there are still several aspects to be improved.
2. It's important to intensify the patriotism education and advocate athletes to compete for the glory of our motherland.
3. The current factors influencing the effect of the closed intensive training: The lack of collective entertainment events during holidays; the training period lasts so long that it's hard for athletes to keep highly active all the time; the monotony of body training; the lack of training methods to encourage active body training.
4. The spare time life quality of athletes determines their training quality from indirect sources. If we can improve their training life from various angles and directions, it will promote to adjust their psychological state in a better way.

Dong Yang and Sun Qi-lin

The Physical Education research institute of Shang Hai Jiao Tong University 200030
 sjtusports@mail.sjtu.edu.cn

The Chinese table tennis team has mastered the development law of the world table tennis technique-tactics and playing methods since the recent half century. We are advanced in the way of the technique-tactics innovation in the world. We are advanced in the way of not only practical innovation but also theoretical innovation. At present, our country has twenty professional researchers about the table tennis theoretical science. Compared with Japan, Sweden, Germany and England etc, China has more professional researchers. Fifteen sport scientific researchers attended the first science representative congress in Rome in March, 1989. Most of them studied sport physiology, sport biomechanics and sport medicine. Only a Chinese representative studied sport training.

Results

Chinese research quantity and outcome quality has not been worse than other countries' for many years. Many research outcomes are created first in the world. On the basis of the incomplete statistics, we has published 1245 foreign theses since 1959 and 1193 technicality articles in science issues and technicality conferences, three professional articles and five books about the rudiment and middling training methods since 1987. We published 1034 technicality articles from 1990 to 2002, which is nearly the total of the foreign published articles for seventy years.

Canada Discus Data Bank collected 1440 table tennis references of some countries in 1990s' excluding Japan, Korea and North Korea.

Table1: The quantity of some countries' table tennis theses in 1990s'

Country	Quantity	Percentage	Country	Quantity	Percentage
China	1097	0.76	Scotland	1	0.07
England	194	0.135	Finland	1	0.07
France	85	0.06	Canada	1	0.07
Sweden	15	0.01	Italy	1	0.07
Germany	12	0.8	Portugal	1	0.07
Spain	10	0.7	Turkey	1	0.07
Russia	4	0.3	America	3	0.2
Australia	4	0.3			

Most of table tennis theoretical articles belong to China, England, France, Sweden, Germany and Spain. Only 23% of theses in 1990s' is foreign. 368 theses among 1140 theses studied the table tennis technique-tactics. 270 theses among 368 theses, 18.75% belonged to China. 75 theses among 368 theses, 5.2% belonged to foreign countries such as England, France, Sweden, Germany and Spain. The theses quantity of every of these countries is 1% of the total. In addition, they only studied the rudiment application of the normal technique-tactics and expounded it. This proves that these countries have not more advanced table tennis researches.

By classifying and analyzing Chinese 1034 technicality articles in 1990s' (Table 3), we can clearly know several characteristics of Chinese table tennis theoretical research.

Conclusion

Theoretical researchers of Chinese table tennis select themes from practice, make abundant experiences into theory and then apply theory to practice again and use practice to test theory and make more advanced theory. So, many professional researches not only have a certain theoretical level but also considerable practical value and answer why innovation can make our technique-tactics training and others retain advanced for a long time from the theoretical level, which is very helpful to cause our table tennis to develop further.

Dong yang and Sun Qi-lin

The Physical Education research institute of Shang Hai Jiao Tong University 200030
 situsports@mail.sjtu.edu.cn

Chinese Table Tennis Team (CTTT) has been thriving without falling for last 40 years. This creates a miracle in Chinese sports stage; also it is very unique in the international sports history. Why is CTTT so thriving, what are their regularities and the experiences of success? This literature is based on the study results which people have done before and what we have on hands now; and referring to the international Table Tennis (TT), by using the methods of literatures, surveys, interviews, comparisons, statistics and logical analysis etc. It compares the technical theories and practical innovations in China and foreign countries. Also it summarizes the regularities of technology-tactics innovation which would make us move forward to accomplish the innovative theories of TT tactics, and enhance the awareness of the innovation methods.

Subjects: this article is based on the world TT line, including China, Sweden, Japan, Germany and Korea and mainly studies of the theories and development law of table tennis technology-tactics in China and foreign countries.

Methods: reference, survey, professional consultation, comparison, statistics, logical analysis.
Results: (1) In China, we have much more technology-tactics terms than they have in foreign countries. These represent our country is advanced on the knowledge of TT regularity, and the profundity of TT basic theories. It has made a solid theory base for our technology-tactics innovation. (2) The innovation of technique is a core part for improving the comprehensive power of TT. To improving the individual level in the winning factors and the group levels between the factors are the keys of technological innovations and precedence. (3) The formation, the development and the innovation of TT tactics is causing the major effect in the development of international TT sports. The changes in our technology are varies. This is the key of getting tactics for our athletes in the competitions. (4) We have 16 kinds of playing style in 5 categories; it takes up 89%. During the 40 years, our new techniques and tactics are appearing continually. It has a major affect on our plenty playing style system. (5) In "The Small TT World", our athletes have formed different playing styles and technology-tactics styles. (6) We have proceeded on the technology-tactics innovation stage; we need to grasp realistic significance of innovation, substantiate the combination of theoretical and practical innovation; then we need to recognize the logical and actable of innovation; and accomplish the playing styles, the style, tools and equipments of technology-tactics unceasingly. Therefore the way to innovation would contain breaths.

Conclusion: this literature makes new ideas for the study of TT technology-tactics innovation. Also, it provides theories and practical information for the development of Chinese TT and the continuance of technology-tactics development. It also has the significant meanings and effects on the development of our other sports.

The effect of tennis participation on bone mass is better retained in male than female master tennis players.

C. Dorado Garcia, J. Sanchis Moysi¹, G. Vicente Rodriguez, G. Garcés² and J.A.L. Calbet

Departamento de Educación Física, Universidad de Las Palmas de Gran Canaria, 'El Cortijo Club de Campo,' ICOT, Gran Canaria, Spain, cdorado@def.upgc.es

Introduction: Tennis imposes a high mechanical load promoting a mark increase of muscle and bone mass in men (Calbet et al., Calcif Tissue Int, 1998, 62, 491-496; Sanchis Moysi et al., Science and Racket Sports II, 1998, 34-43) and young women (Kontulainen et al., J Bone Miner Res, 2002, 17(12), 2281-9; Bass et al., J Bone Miner Res, 2002, 17(12), 2274-80). In this regard, tennis may be proposed and an osteogenic sports to prevent or attenuate osteoporosis later in life. However, the extent to which master tennis players have greater bone mineral content (BMC) and density (BMD) in clinically relevant areas than their sedentary counterparts remains unknown. The aim of this study was to examine the effect of tennis participation on the bonemass and density in postmenopausal women, as well as in men of similar age. Special attention was given to describe the longitudinal effects of tennis participation on postmenopausal tennis players.

Methods

The BMC and BMD was determined in 17 male tennis players (55±10 years, 79±10 kg body mass, 173±8 cm height, and 26±6% body fat) and 9 female tennis players (60.5±1.3 years, 60.2±6.5 kg body mass, 161.2±1.5 cm height, and 39.0±1.6% body fat) using dual energy X-ray absorptiometry (DXA; Hologic QDR-1500). The mean participation in tennis was 26.8±6.8 years, while the actual time devoted to tennis participation was 3 hours per week in both groups. The same examinations were performed in the control groups (15 men and 19 women, non-exercisers) from the same population). To account for small differences in body size and time from menopause between female tennis players and controls, groups were compared with ANCOVA using these variables as covariates (Table I). Values reported as mean ± SD, significant differences established at p<0.05.

Results

MALE tennis players showed 16 and 10% greater BMC and BMD in the legs than the control subjects (p<0.01). In addition, 10-30% greater BMC and BMD was also observed at the hip regions (femoral neck, greater trochanter, inter-trochanteric area and Ward's triangle) and lumbar spine (L₂-L₄) in tennis players compared with the controls. However, FEMALE tennis players showed, in general, similar BMC and BMD values than their sedentary counterparts in all these regions, except a trend to a greater leg BMC in the tennis players (p=0.06). This apparently lower osteogenic value of long-term tennis participation in women was confirmed in a follow up study in which, 7 postmenopausal tennis players and 10 female controls from the same population were examined, two years later. As reported in Table I, long-term tennis participation only resulted in a marginal greater BMC and BMD at the greater trochanter and inter-trochanteric femoral regions.

Table I. ANCOVA analysis of trochanteric and inter-trochanteric BMC and BMD in female tennis players and controls.

		Covariates			
		Time from menopause (TM)	TM and body mass (BM)	TM and BM and height	P
BMC greater trochanter	Tennis	6.82±0.58 vs 7.60±0.56	6.91±0.57 vs 7.71±0.55	6.88±0.60 vs 7.67±0.59	<0.05
	Control	7.37±0.48 vs 7.07±0.46	7.28±0.47 vs 6.99±0.46	7.33±0.49 vs 7.02±0.48	<0.05
BMD greater trochanter	Tennis	0.68±0.04 vs 0.68±0.04	0.69±0.04 vs 0.69±0.04	0.70±0.04 vs 0.69±0.04	<0.05
	Control	0.66±0.03 vs 0.65±0.03	0.65±0.03 vs 0.64±0.03	0.65±0.03 vs 0.64±0.03	<0.05
BMC inter-trochanteric	Tennis	17.38±1.09 vs 17.78±0.95	17.74±0.96 vs 18.11±0.82	17.56±0.99 vs 18.04±0.86	<0.01
	Control	17.74±0.90 vs 18.32±0.78	16.99±0.79 vs 18.09±0.68	17.11±0.81 vs 18.14±0.71	<0.05
BMD inter-trochanteric	Tennis	1.02±0.06 vs 1.05±0.06	1.04±0.06 vs 1.07±0.05	1.05±0.06 vs 1.08±0.06	<0.01
	Control	1.03±0.05 vs 1.01±0.05	1.02±0.05 vs 1.00±0.04	1.01±0.05 vs 0.99±0.04	<0.01

Conclusions

The osteogenic effects of tennis participation are better retained in age male than females.

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P. Dronne and G. Avanzini

Laboratoire de la Performance Motrice, Faculté du Sport et de l'Éducation Physique, rue de Vendôme, B.P. 6237, 45062 Orléans cedex 2, France, philippe.dronne@laposte.net

This work studies the coaching in table tennis. It's feared in situation of competition from the theories of the 'Situational action' (Suchman, 1987, *Raisons pratiques*, 1, 149-170), therefore granting a major place to the actors points of view. Conceived as a collective activity, the coach-athlete system is studied in its competitive environment. Based on the concepts of the distributed cognitions, it's essentially strategic dynamics that is studied through the analysis of singular and collective activity of the table tennis player (Seve, 2000, *Le tennis de table : entraînement et compétition*, FFTT).

To access the point of view of every actor implied in the action, without breaking the collective dynamics, we used a particular interview : the "self-confrontation" (Theureau and Jeffroy, 1994, *Ergonomie des situations informatisées*, Toulouse, Octarès) so-called "crossed self-confrontation" (Clot et al., 2000, *Éducation permanente*, 146, 17-25). This approach presents the interest to provoke collective discussions focused on the action, from the action.

The research lasted one year and implies a junior table tennis player of national level and his trainer-coach. Their collaboration has been studied from movie data allowing to record both their behaviours and their verbal exchanges linked to coaching. 43 parts have been shot. It's the 27th part of the collaboration that is analysed here and presented. We chose the crossed self-confrontation interview in 3 stages:

- The pictures first acted as support for 2 individual interviews of self-confrontation, of the player's own game and his coach, on the same game. These interviews were filmed in order to follow the pictures as support to the given out points of view.
- the second stage implies that every actor learns separately about the film of his partner's self-confrontation (the player is confronted to the coach's film and the coach to the player's one). The actors were invited by the researcher to express themselves on the supports.
- the last implies the two actors, simultaneously, for a collective interview, with the researcher, on the basis of the game's pictures.

These 5 interviews have been retranscribed verbatim, analysed then by iterative coding by categorization of the verbalizations (Strauss and Corbin, 1990, *Basics of qualitative research : grounded theory, procedures and techniques*, Beverly Hills, CA), regrouping the elements that seemed to govern the activity of the collective system table tennis player. These categories enabled to retrace "the history" of the game through a diagram of each actor's cognitions in situation of competition.

The approach by crossed self-confrontation provides results which indicate that each actor doesn't really discern the other's coherence. It seems that this phenomenon, that's likely to be incomprehension, tends to decrease the system's performance. The procedure allowed to reveal the coherence of each actor to the other. So the two actors are interested in and debate collectively - always with 'action' as support : revelations, reflections and mutual questions seem favourable to progression, in a way of discovering other's intentions, in a way of understanding his actions and activity. The analyses reveal different categories of misconceptions which indicate that the actors implied in the coach-athlete system consider their activity nor as collective, nor as perfectible. Avoiding to generalize, the approach by crossed self-confrontation is here changing, based on these two measurements.

G. Ducher, C. Jaffré, A. Arlettaz and D. Courteix

Laboratoire de la Performance Motrice, UFR STAPS d'Orléans, rue de Vendôme, BP 6237, 45062 Orléans Cedex 2 and Inserm ERIT-M 0101 / CHR d'Orléans, France, gaele_ducher@hotmail.com

Introduction. Large side-to-side differences in muscular mass and bone mineral content have been reported between both arms in tennis players. The comparison between the dominant and non dominant limbs offers the opportunity to study the effects of unilateral impact-loading on the skeleton, the genetic, hormonal and nutritional factors being supposed similar in both limbs. The marked increase of bone mineral content in the dominant forearm could be the result of a higher muscular activity in addition to the frequent impacts of the ball encountered by the player's arm via the racket (Kannus et al., 1994, *Bone*, 15(3), 279-284; Krahl et al., 1994, *American Journal of Sports Medicine*, 22(6), 751-757).

Our objective was to investigate the relationships between muscular function, muscle hypertrophy and bone mineral content in the forearms of tennis players.

Methods. Fifty-two tennis players (28 men and 24 women) were recruited. Their mean age was 24.1 ± 5.6 years and their total training time amounted to 3351 ± 2412 h. Grip strength (GS, N) was measured with a hand-held dynamometer equipped with a strain gauge (Scaine ZF 200 kg - n°30141). Lean tissue mass (LTM, g) and bone mineral content (BMC, g) were determined by dual energy X-ray absorptiometry (Delphi QDR® Series, Hologic Inc., Waltham, MA, USA). Those parameters, measured on the forearm and hand, were derived from the whole body analysis obtained directly by the device. The comparison of the parameters measured at the dominant (D) and non dominant (ND) arms was performed using a parametric paired t-test. The same test was used to compare the side-to-side differences in GS, LTM and BMC, expressed as percentage of the non dominant value ($\Delta_{\%} = (D-ND)/ND \times 100$). The potential association between the variables was analysed by the Pearson product moment correlation coefficient.

Results. LTM, GS and BMC were significantly higher at the playing forearm ($p < 0.0001$). The side-to-side difference concerning BMC reached $19.9 \pm 11\%$. $\Delta_{\%}$ LTM and $\Delta_{\%}$ GS were less pronounced: 14.8 ± 5.8 et $15.9 \pm 9.5\%$ respectively ($p < 0.05$). LTM and BMC correlated positively in the dominant and non dominant forearms ($r = 0.90$ and $r = 0.91$, $p < 0.0001$), the same for GS and BMC ($r = 0.83$ et $r = 0.84$, respectively, $p < 0.0001$). When taking LTM into account the correlation between GS and BMC was no longer significant. This result suggests that the relationship between GS and BMC could be mediated by LTM. Moreover, the total training time correlated significantly to $\Delta_{\%}$ BMC ($r = 0.45$, $p < 0.05$). This correlation remained significant when $\Delta_{\%}$ LTM was introduced as a co-factor. In this case, the total training time explained only 12% of the $\Delta_{\%}$ BMC variance ($p < 0.05$).

Conclusion. The relationship between the muscular parameters and the bone mineral content seems to be not different between the playing forearm and its counterpart that is much less active. The strong correlation observed between LTM and BMC at the dominant forearm suggests that tennis exerts its positive influence on BMC mainly through muscle mass. However, when the muscular asymmetry ($\Delta_{\%}$ LTM) is taken into account, the total training time still explains 12% of the variance of $\Delta_{\%}$ BMC. This observation seems to reveal that the repeated impacts of the ball on the racket must have an osteogenic effect directly linked to the mechanical vibrations transmitted to forearm bones.

Managing the table tennis players for now and future

C.O. Fasan

Department of the faculty of education, university of Lagos, Nigeria, fasan@unilagonline.com

One of the greatest assets which a coach or club can boast of and produce result are the players. They are so valuable that their form, skill, exposure and personality are enough to draw the attention of marketers and spectators. However it has been observed over the years most especially in developing countries that we only concentrate of the physical development of the players and other aspects i.e. social, psychological, economic are neglected. This is the reason why our players have a short span of play and many of them ended either in penury or as drop outs. This is why we need to manage our athletes for now and future. Managing the table tennis players is the process of developing and equipping the players an coal and emotional needs are met by the handlers and he will be useful to the club in accomplishing clubs objectives and meeting his personal objectives.

Zeigles and Bowie (1983) defined management as involving the execution of managerial acts, involving conceptual technical, human and skills, while combining varying degrees of planning, organising, staffing, directing and controlling within the management process to assist an organisation to achieve its goal. Club managers, handlers and coaches in their attempt to produce champion table tennis players must endeavour to manage the following

1. Skill
2. Health
3. Psychology
4. Social Relationship
5. personality
6. Income
7. Future i.e., retirement.

Managing the table tennis players is not a 'it and run' business. It is a conscious and deliberate action to bring out the best in athletes. All those who are involved in this production of table tennis players must bear this mind. Table tennis players will show more commitment if they are sure of their future regardless of their present playing status. The life of table tennis player can be represented as plateau.

He rises to stardom with much pain through training and playing. After some time in gets to a plateau where he is not improving or declining. However, his productivity is in doubt by coaches. After sometime he starts the down ward journey and if he has not prepared for the future what will happen to him? This is a warning for club managers and coaches. They must prepare for the future of their athletes.

Achieving objectivity in table tennis players selection

C.O. Fasan

Department of the faculty of education, university of Lagos, Nigeria, fasan@unilagonline.com

One of the hallmarks of Human Resources Management Process is the ability to select accurately those candidates that will best fit the vacancies in organisations. How do they go about this? It is by developing a good job analysis with identifiable job description and job specifications. Over the years, it has been observed that the selection procedure in table tennis can equally be faulted because they lacked identified selection criteria. There is the need to ask our coaches how do they select their players? Is it through world ranking or rating? How are we sure that a player with a superior ranking can consistently be in form to defeat those of lower ranking. What role does Halo effect have on be so extraneous in the selection of table tennis players, to guide against bias nature of our selection procedure, there is the need for coaches and club handlers to develop a selection criteria which will be open and unbiased for the sake of objectivity. Some of these selection criteria are:

- Age
- Experience
- Exposure
- Skills
- Socio economic status
- Physical fitness
- Personality.

After identifying this criteria, there is the need to attach scores to them. These scores are called weights. The coaches and judges are given a range of these scores within the limit of which they can operate. These team of judges can then be asked to score each player and their marks added together to find average.

There are so many advantages in objectivity players put in their best to make sure that they get selected. There is no room for fear any longer. It will promote keen competitions. Players can plan ahead for the selection. Undue interference is removed.

To get the best of table tennis players to represent the country there is the need for objectivity in selection.

V. Fayt, G. Quignon and S. Lazzari

Laboratoire d'Analyse Multidisciplinaire des Pratiques Sportives (LAMAPS), UFR STAPS Liévin, University of Artois, France, yfayt@nordnet.fr

Introduction

A table tennis drive may be described as a speed-accuracy trade-off. To win a point, player should induce the highest level of uncertainty in opponent, keeping the highest level of precision during the rally. In this study we have analyzed drive accuracy evolution depending on the intensity of the exercise. Players were faced with an easy to perform exercise with increasing intensity. Results concerning accuracy, movement execution and effort managing have been analyzed.

Method

Players should perform a forehand drive towards a target, of 21 cm diameter, placed in the opponent half-table. The exercise intensity was controlled by increasing balls projection rate (steps of 6 balls/min every 30 seconds). Subjects were expert players (n=4, National ranking) or confirmed players (n=5, Regional ranking). Accuracy (% of balls hitting the target), movement kinematics (goniometer placed on elbow/joint, 100 Hz acquiring frequency, Biopac) and heart rate (cardiofrequencemeter, Polar Accurex Plus) have been recorded.

Main results

Results show a decadence in performance during the exercise ($r^2 = .91$) and an increasing heart rate. These two variables are correlated with a negative slope ($r^2 = -.95$). The evolutions observed in all variables depend on practice level for accuracy ($p < .01$), for movement speed ($p < .05$) and for heart rate ($p < .05$).

Evolution analysis of backward swing and driving phase during exercise shows that main adaptations in kinematics are produced during backward swing (stability of speed profile and of lower rest point).

Discussion and Conclusion

Gradually increasing exercise intensity, we can observe in table tennis players a decreasing in performance correlated with increasing in heart rate and mean execution speed. Moreover, adaptation mechanisms depend on practice level: movement speed is coupled to projection rate for regional level players while it proceeds by steps in national level players. Finally, backward swing movement appears to be a fundamental phase for drive movement efficiency.

These results, without requiring sophisticated equipments, could help trainers in defining for a given subject the critical intensity and the exercise duration thresholds for which he/she cannot maintain an acceptable level of accuracy. Over these thresholds we can notice compensation movements which prevent players from developing an efficient game.

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V. Fayt, G. Quignon and B. Catoire

Laboratoire d'Analyse Multidisciplinaire des Pratiques Sportives (LAMAPS), UFR STAPS Liévin, University of Artois, France, yfayt@nordnet.fr

Introduction

During last few years, important changes in table tennis rules have been introduced: increasing in ball weight (from 2.5 to 2.7 gr.) and diameter (from 38 to 40 mm), and reducing match's score (from 21 to 11 points). Supposed to reduce rallies speed, these modifications should require adaptations in player way of acting and in his/her physical preparation, due to observed increasing duration in rallies (see players and trainers comments published in domain journals, Jégouzo, 2001, FTT Magazine, 750, 16-17; Sève, 2001, FTT Magazine, 758, 12-13).

In this study we analyze movement adaptations and physiological implications caused by changed ball size. We suppose that increasing the diameter of table tennis ball generates adaptations in player's drives, mainly in terms of movement amplitude and energy consumption (deduced through heart rate and effort perception). These adaptations depends on player's practice level.

Method

Subjects are asked to perform a returning task of 60 balls at the rate of 1 ball per second, both with 38mm and 40mm balls. In test 1, subjects are experts players (n=9, National level) and beginners (n=9, subjects who have acquired fundamentals of activity). In test 2, subjects (n=11) have at least a 5 years experience in table tennis practice. We record precision and amplitude of drive movement (test 1), precision, heart rate and effort perception by means of Borg scale (1998, Borg's perceived exertion and pain scales, Champaign, IL, Human Kinetics) (test 2).

Main results

Test 1: experts are more accurate than beginners (67% of success versus 43%; $F_{(1,16)} = 37.8, p < .05$) and both practice levels show a lower performance with 40mm balls ($F_{(1,16)} = 6.8, p < .05$). Results show a movement amplitude adaptation (amplifier movement) changing from 38mm to 40mm balls exclusively for high level players ($F_{(1,16)} = 7.4, p < .05$).

Test 2: we find again, as in test 1, higher performance with 38 than 40 mm balls ($73 \pm 10.1\%$ of success versus $67.7 \pm 8.2\%$; $p < .05$). On the other hand, no significant differences are observed concerning heart rate (170.3 ± 12.2 bpm versus 170.3 ± 13.3 bpm; $p = ns$) and perceived effort (14.4 ± 1.3 versus 14.9 ± 1.6 ; $p = ns$).

Discussion and conclusion

These two experiments show that changing in ball diameter, from 38 to 40 mm, generates a reorganization of pattern movement and that movement adaptation depends on players' practice level. Results put in evidence that table tennis players, despite rules changes, try to accelerate movements and to play more powerfully, maintaining a constant effort.

B. Fenwick, M. Hughes and S. Murray,

Centre for Performance Analysis, University of Wales Institute Cardiff, Cyncoed Road, Cyncoed, Cardiff, CF2 6XD, UK, MHughes@uwic.ac.uk

Hughes, Wells and Matthews (2000, *Journal of Human Movement Studies*, 39, 85-104) established performance profiles for women squash players at recreational, county and elite levels of play. A way of expanding these profiles came to light during a discussion with the SRA psychologist. It highlighted her interest in extremes of body language and the resultant outcomes of the next 3 or 4 rallies. We realised that we had these outcome data in our databases gathered from computerised in-event analyses of winners and errors. By writing another analysis program we calculated a running score (momentum) for a player during a game. We gave a winning shot by a player a '+1' score, an error a '-1' score, and if the opponent hit the rally end shot, or it was a let, the running score stayed the same. This would show any swings in momentum during the match, then the video could be used to analyse the body language and try to understand the reason for these swings.

When examining the graphs of different matches by the same player similarities in patterns were noticed. Perhaps there were aspects of concentration and/or risk taking that repeated themselves in matches, thus giving each player some sort of 'momentum profile'. The aim of this work was to examine the possibility of these types of profiles and examine their stability, variability and explore what they could mean to the working analyst.

Matches of 6 male, and 6 female, elite squash players (N=8 per player) were analysed to examine the length of the 'peaks' of momentum in a match, and their corresponding amplitudes, and to compare these characteristics to those of the 'troughs' of momentum. Inevitably large variations were found within each player's set of data, but all of these characteristics of the profiles stabilised to within 10% of their respective means within 6 of the 8 matches, for all the players. The troughs in the data did not show any clear patterns with respect to world ranking, but the lengths of the peaks in momentum showed that, for both men and women, that the world number one's had values well in excess of players below them. A X^2 analysis was used and the patterns showed significant differences between players ($P < 0.05$).

It was concluded that, as part of an overall playing profile, these momentum profiles can add valuable quantitative data about the concentration and the application of a player's style and tactics. Further, the best players have strong momentum profiles, whilst some highly ranked players have weak profiles that could, if strengthened, vastly improve their overall performance. It is recommended that these types of profiling be extended to other individual and team sports.

L. Fernandez

"Savoir Gagner", 31 boulevard des Recollets, 31400 Toulouse, France, lfernandez8@wanadoo.fr

There are thirty years, an haunting question obsessed a young student :

«What's going on in the head of someone who makes a success or who fails ?

Is « this thing » the same for everybody ? Can we learn this thing ? How can we learn it ? »

He was practising sport.

His laboratory of investigation was the sport competition.

As there weren't a lot of books about sport psychology, he had to constitute a methodology of investigation based on phenomenology. He based his clinic approach on two things : efficacy and good sense.

He was the first professional to introduce and to use sophrology in the French sport. Every time he was collaborating with teams or athletes, he said : « you learn me your sport and I try to help you to reach more easily your aims. The surrounding frilosity of the sport has bring him to intervene in emergency, when « everything had been tried ».

He has intervened in most of sports and in racket sports.

Responsible of the most important link, the mental, he has collaborated with other actors of the

performance, in the conquest of world victories, of some Olympic medals.

During this journey, he has written some rare scientific articles, seven books and has concluded his work by publishing a practical encyclopaedia concerning the mental.

About thirty years later...

What about his original haunting question ?

What kind of look does he have about the psychology in the sport ?

What is the situation of a mental assistant in a team ?

What are his responsibilities ?

What can be the future of this embryonic job ?

So is the journey your are invited to by this former student ...

O. Fomez-Bertaud, E. Rolland and G. Saillant

Groupe Hospitalier Pitié-Salpêtrière, Service de Chirurgie Orthopédique et Traumatologique, Chirurgie Réparatrice, 47-83 Boulevard de l'Hôpital 75651 Paris Cedex 13, France, myriam.ares@psl.ap-hop-paris.fr

A lot of publications relate about lateral epicondylitis and its surgical treatment. They all report good results for short and medium-term. The purpose of our study was to check the long-term results through a series of patients operated on by the same technique and the same operator (in 82% of the cases). The elbow function, more than 10 years after surgery, was the purpose of this study, through 28 elbows operated on 13 years before (from 10 to 15 years).

Materials and method

From 1985 to 1990, 31 patients have been operated on for lateral epicondylitis, after failure of a well-driven medical treatment. 25 of them (15 men and 10 women) have been reviewed : all of them were called by phone and completed a questionnaire. The average age was 43,8 (from 35 to 58). The prevailing arm was injured in 80% of the cases, 3 patients were injured on both arms, and the non-prevailing arm was interested in 2 cases. The average delay between the beginning of the symptoms and surgery was 19,2 months (from 5 to 48 months). 93% of the patients underwent steroid injections (with an average of 3,5 injections - from 1 to 9) and all of them underwent about 3 different medical treatments before surgery. 20 among them were practicing sport (tennis 80%, golf 15%, others 5%).

Surgical technique

It was the same technique for all patients, consisting in a systematical and complete desinsertion of the epicondylar common tendon. This was completed by a partial and very superficial epicondylectomy.

Early rehabilitation was proposed with exercises for getting back the extension of the elbow and stretching of lateral epicondylar muscles, passively then actively.

The final evaluation of our results was determined through the Roles and Maudsley classification, the most used way for this kind of elbow troubles.

Results and discussion

We obtained 93% of good results (75% very good and 18% good). This shows the efficacy of a simple surgical technique with the possibility of practicing sports in 95% of the patients. The lower level of practicing was explained by the increase of age rather than by the elbow problem. This surgical technique was accused to weaken the elbow and increase the risks of elbow destabilisation (lateral epicondylar muscles are supposed to be active stabilization agents). Our study does not show any instability or complaint about weakening of the elbow. The study of sports activities (8 regular tennis-players, 12 occasional sportsmen) showed that their recovery was possible without any difficulty in an average delay of 4 months, at the same level.

Conclusion

The good initial results seem to be definitively acquired. This leads us to propose this surgical way of treatment after a useless well-driven medical treatment. This simple standardized technique affords to get back to sports practicing most of time.

G. Furjan-Mandić¹, M. Kondrić² and M. Kasović¹

¹*Faculty of Kinesiology, University of Zagreb, Croatia, g.furjan@fk.hr*, ²*Faculty of Sport, University of Ljubljana, Slovenia*

The new materials used for rackets have had a major impact on development of table tennis technique over the last twenty years. To a certain extent, they have also diminished the interest and joy of the spectators. The novelties introduced by the International Table Tennis Federation in last three years call for a new approach to technical, tactical and physical preparation. The introduction of the larger (40 mm) ball changed the way some strikes are executed. Harder strikes and slower ball demand adaptations of technique and better physical preparation from the players.

The aim of our study was to analyse kinematic characteristics of forehand strike using the 38 mm and the 40 mm ball. Kinematic analysis enables precise identification of any strike technique and hence also comparison of different techniques. The analysis was carried out using the Elite system, which is designed for recording and evaluating kinematic parameters. This enabled us to calculate the differences in forehand strike technique caused by replacing the 38 mm ball with the 40 mm one.

The comparison of selected kinematic parameters proved that differences arose in the amplitude of forehand strike of the tested player due to increased ball size. The gathered data should facilitate planning of the training process, especially for promising young players.

The physiological demand of 3 most popular badminton strokes.

A. K. Ghosh

Sports Science Unit, School of Medical Sciences, University Sains Malaysia, Kelantan, Malaysia, asokghosh@kb.usm.my

Badminton is a most popular game not only in the whole world, but also in Asian countries from where most of the World Champions emerged. Badminton contains execution of various strokes in combination with smooth and quick movements to the different corners of the court from the middle to secure points and win over the opponent. Though studies on physiological demand of the game are available in literature (Ghosh et al, 1990; Dias and Ghosh, 1995), yet studies on the physiological analysis of various badminton strokes is scanty. Hence, an attempt has been made to investigate the physiological demand of three most popular badminton strokes, e.g., over head smash, over head toss and over head drop on the basis of heart rate and blood lactate concentration. The study will certainly help the coaches and other specialists in finding out the demand of each badminton strokes, so that, he can prepare the player to adopt specific strokes to execute and win, according to the physiological capacity of the player.

In the 1st phase of the study, VO_2 max of all the players was determined in the laboratory following a graded exercise protocol on a bicycle ergometer, till exhaustion. The 2nd phase of the study consisted of playing over head smash, over head toss and over head drop on different days. The player has to play on one side of the court and he is fed the shuttle from the opposite side. The heart rate was measured on a PE 3000 (Polar Electro, Finland) polar sport tester (heart rate telemetric device) for every 5 sec interval and the blood lactate concentration; on an YSI 1500 sport model lactate analyzer. Similarly, the heart rate and blood lactate concentration were also determined during movement on the court (shadow practice), without any shuttle, to differentiate, the demand of movement and the demand of strokes.

The mean VO_{2max} of the present players is 57.4 ± 7.02 ml/kg/min. The mean heart rates during over head smash, over head drop, over head toss and shadow practices are 183 ± 5 , 180 ± 6 , 176 ± 7 and 182 ± 7 beats/min, while the mean blood lactate are 11.6 ± 1.9 , 9.8 ± 1.7 , 9.2 ± 2.3 and 12.4 ± 2.3 mMol/L, respectively.

The study indicates that the heart rate and blood lactate response during execution of over head smash, over head drop and over head toss are similar and no difference exist among them. Even the shadow practice also demands the similar physiological response like other 3 strokes. Physiologically, the contribution of strokes in badminton is difficult to separate from the contribution of movement.

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Effect of the ground surface on the physiological and technical responses in young tennis players

O. Girard and G.P. Millet

Faculté des Sciences du Sport, Université de Montpellier 1, 34000 Montpellier, France. Irucette@wanadoo.fr

Introduction

The effects of the type of ground surface on the physiological and technical characteristics of the tennis game have not been investigated yet (Richers, T.A., 1995, Journal of Human Movement Studies, 28, 73-86). The purpose of this study was to test the hypothesis that to play on clay would induce longer exchanges and therefore different metabolic responses than on Greenet[®].

Methods

Seven young (15.1 ± 2.4 yr) tennis players well-trained performed firstly a maximal test to exhaustion and secondly two randomised 30-min games on clay and on Greenet[®], respectively. The following variables (Oxygen uptake, minute ventilation, heart rate, respiratory exchange ratio) were measured by a portable breath-by-breath gas-exchange analyzing system (K4b², Cosmed, Italy), blood lactate concentration by the Lactate Pro (Arkray, Japan) and the technical characteristics (duration of the exchange, distance ran and number of consecutive shots...) by video analysis.

Results

Mean physiological parameters were higher ($p < 0.05$) on clay than on Greenet[®]: Oxygen uptake (40.3 ± 5.7 vs. 35.9 ± 7.5 ml \cdot kg⁻¹ \cdot min⁻¹), minute ventilation (58.9 ± 15.6 vs. 50.7 ± 12.3 l \cdot min⁻¹), heart rate (181.8 ± 11.9 vs. 172.8 ± 17.2 bpm), respiratory exchange ratio (1.04 ± 0.07 vs. 0.98 ± 0.07); but lactate concentration was not different (2.36 ± 0.47 vs. 3.08 ± 1.12 mmol \cdot l⁻¹). Similarly, the technical characteristics were higher ($p < 0.01$) on clay: duration of the exchange (7.2 ± 1.7 vs. 5.9 ± 1.2 s), distance ran (9.8 ± 2.5 vs. 7.7 ± 1.7 m) and number of consecutive shots (2.5 ± 0.5 vs. 1.9 ± 0.4). High correlations were found between several physiological and technical characteristics: % VO_{2max} and number of consecutive shots ($r = 0.99$; $p < 0.001$), % VO_{2max} and duration of the exchange ($r = 0.97$; $p < 0.001$) and % HR_{max} and distance ran ($r = 0.92$; $p < 0.01$).

Discussion

The differences in the technical characteristics explain to a great extent the physiological differences observed between clay and Greenet[®]. Although the anaerobic contribution seems not different, the aerobic pathway is more solicited on clay due to the length of the exchanges allowing a greater increase in $\dot{V}O_2$ and HR.

Conclusion

The present results showing physiological and technical differences between clay and Greenet[®] suggest that the young players may benefit to practice on different ground surfaces; on clay to increase their endurance and on various surfaces to enhance their technical skills.

S. Guilbert

APS & Social Science laboratory, University of Strasbourg, France, seb.guilbert@wanadoo.fr

Introduction

The work of French and foreign language about violence in sport is nearly systematically focused on collective sports which imply a physical contact, such as essentially football, rugby, ice hockey, handball and basketball (Lassalle, 1997, in La violence dans le sport, Paris, PUF ed.). On the contrary, the studies on individual sports are rare. Actually, everything happens as if violence was only physical and reserved for team sports. But, violence is, by definition, a "subjective and relative" notion (Michaud, 1978, in Violence et politique, Paris, Gallimard ed.); it is a product of cultural areas (sporting areas) and an object of representations. Everybody does not recognize the same things as violence. Also, a survey has been conducted in two sports of rackets: tennis and table tennis. This research, inspired from the sociological model of Pierre Bourdieu (1979, in La distinction, Paris, Minuit ed.), suggests to materialize violence in those areas and to explain it from sporting and social properties of agents.

Methodology

The study deals with a population of 90 competitors: 45 from a national level and 45 from a regional/departamental level. They are from 18 to 30 years old and most of them come from clubs of the Urban community of Strasbourg. A questionnaire realized from a chart of indicators, structured around three dimensions, has been delivered and filled on the places of activities of the competitors. It was directly aimed to: the perception of violence in the sporting areas (types of violence, levels accidents, fair-play...), the "practical" properties of the agents to violence (used types, occurred injuries, aims of violence...) and their social properties (socioprofessional categories, degrees...). The collected data led us to a computerized statistical treatment (SPAD.N) that led us to the results below.

Results - Discussion

Tennis and table tennis, considered as well controlled and secured areas, are not structured of "hard violence" but of "soft violence": psychological violence (wars of nerves, harassment, moral failure- in the jargon, we say "to blow one's top"...), and the violence of the language (insults, threats, disputes...) with or without gestures (gestures showing resentment or irritation: throwings of rackets, kicks in the table, in the net...) toward oneself or the opponent are indeed the major types of violence in these sports of rackets. These types of violence often happen and are intense according to what the players say. They are disciplines where the accidents are rare, minor, and where the players behave rather honestly and with fair-play.

The features of these areas to violence can be explained by the social and sporting properties of their agents. The results first reveal that the table tennis players and the tennismen hold the properties of the areas to which they belong: they use soft violence, few of them had accidents, they are fair-play... Moreover the results make appear the fact that the managers, the intermediary professions, the employees and the most graduated (A-Level +2, +4) are more represented in these sports of soft violence. These results, in general, thus tend to confirm those obtained by Færeau (1970, Les accidents du sportif, medical thesis), Bourdieu (1979, in La distinction, Paris, Minuit ed.), Wasser (1989, Actes de la recherche en sciences sociales 80: 2-21), Suaud (1989, Actes de la recherche en sciences sociales 79:2-20), Thomas (1993, in Sociologie du sport, Paris, PUF ed.).

A. Guillot¹, C. Collet¹ and A. Dittmar²

¹ CRIS, UFR STAPS de Lyon, 27-29 Bd du 11 Novembre 1918, 69622 Villeurbanne Cedex, France.

aymeric.guillot@univ-lyon1.fr

² Microcaptiveurs et microsystèmes biomédicaux, Laboratoire de Physique de la Matière, CNRS UMR 5511, INSA, Lyon, France.

The aim of this study was to question the impact of environmental context on motor imagery (MI) quality. MI is a dynamic state during which a subject simulates an action mentally without any body movement. Athletes represent action mentally just before competing (Hall et al., 1990, The Sport Psychologist, 4, 1-10; Munroe et al., 2000, The Sport Psychologist, 14, 119-137) because several studies evidenced that MI help to improve motor tasks performance in closed-skills, but also in open-skills such as table tennis (Li-Wei et al., 1992, The Sport Psychologist, 6, 230-241; Lejeune et al., 1994, Perceptual and Motor Skills, 79, 627-641). To be effective, mental training should be close to spatio-temporal characteristics of actual execution (Kourou et al., 1998, European Journal of Applied Physiology, 78, 99-108). However, the effect of the environmental context in which MI is carried out has never been studied. It was expected that carrying out MI in an environment close to actual practice would help subjects to build up the mental representation of action. MI should thus be more effective in such a context rather than in a neutral environment.

Thirteen regional and national table tennis players took part in this experiment. Subjects had to perform a forehand topspin after an experimenter had served in real conditions (reference task) and during 2 MI sessions (experimental task), conducted through 2 different conditions: Neutral Imagery (NI) and Context Imagery (CI). Subjects had to represent the table tennis sequence from the opponent serve until hitting the ball with the forehand topspin technique. NI was performed in a seated position and in a neutral environment, i.e. without any information from the table tennis context. Conversely, during CI, mental representation was carried out while subjects handled their paddle while standing in front of the table and wore sports clothes (as if they were ready to act). Subjects started mental representation when the experimenter started to bounce the ball on the table, just before serving. Three Autonomic Nervous System (ANS) variables (Skin Resistance-SR-, Skin Temperature-ST- and Instantaneous Heart Rate -IHR) were simultaneously and continuously recorded as dependent variables.

ANS responses recorded during actual practice (AP) were considered the reference. Longer SR responses were observed during AP than during CI and NI ($p < 0.01$). IHR response amplitude was higher during AP than during both CI and NI ($p < 0.001$). Duration and amplitude of ST response were also longer and higher during AP than during CI and NI. ($p < 0.001$). Each imagery condition elicited a specific ANS response pattern: shorter SR responses during NI compared to CI ($p < 0.05$). NI elicited a weaker bradycardia than CI ($p < 0.01$) whereas IHR response duration was not different according to each imagery conditions. Conversely, no significant difference emerged between imagery conditions through ST duration and amplitude.

ANS responses during MI were weaker and shorter than those observed during AP. This is probably due to a difficulty to build up a mental representation of movement. However, ANS responses during CI were closer to those recorded during AP. Such a result shows that appropriate environmental conditions may facilitate subjects' ability to imagine the motor sequence. MI sessions performed in an appropriate stimulation context are thus more efficient than those performed in neutral conditions.

H. Hammer

Berlin Table-Tennis Association, Paul-Heyse-Str. 29, 10407 Berlin, Germany,
h.hammer.berlin@gmx.de

One may better understand and evaluate the differences, the pros and the cons of the 21-point format and the new 11-point game by a compared analysis. This study describes first (and maybe at the first time in the recent discussion) the clear organisation of the game by the traditional 21 point format. The winning point in a close game (21:19 or 22:20) was reached after eight rotations of 5 serves and receives (four times for each player). This logic is no longer observed in the new 11-point-format. The serve rotation is no longer consistent with the end of the game. With a serving and receiving cycle every 2 points the game should be won by the player who scores 9 points first. By a change from what is now a 2-serve rotation to a new 3-serve cycle, a close game will end after 8 changes and results 13:11, unless both players score 12 points.

The purpose of this study is to investigate the new scoring rules (2 serve rotations and 11 Point Format) in single and double games compared to the old organisation with a 5 or 3 serve change and the 21 or 13 point format respectively.

The result shows that there are some technical problems in the 11 point game which can be corrected easily by cycles of service and receive every three points resulting in a change to the 13 point scoring. This will be advantageous to players, umpires and spectators. The benefits will be greater in double games than in singles especially in the last possible set with changing table ends and with an additional change of serving and receiving order.

The study also discusses the influence of the scoring format to the quality and technical content of table tennis. The 11-point format leaves many spectators with the impression that chance plays a much bigger role over a real test of ability. The too quick serving and receiving order is even more unfavourable because „great players have complete sets of strategy, starting from serving to gaining control of the rhythm. They need more than 2 serves to implement their strategies and to show their abilities to vary tactics and to play to their best abilities for the spectators“.

With a very little change (3 serve rotation, 13 point game) it will be possible to remedy all the new inconveniences and keep all advantages of the new format with respect to the traditional organisation of the game: high mental competition, much greater frequency of situation, more critical situations, and quick decision in each game.

C. Hausswirth¹, J.M. Vallier², P. Le Van³, B. Reine⁴, P. Limouzin⁵ and C. Jeanjean⁵

¹Laboratoire de biomécanique et physiologie, INSEP, 11 avenue du Tremblay, 75012 Paris, France, ²Laboratoire d'ergonomie sportive et performance, Université de Toulon-Var, 83000 Toulon, France, ³Département médical, INSEP, ⁴Laboratoire d'Informatique Appliquée au Sport, INSEP, ⁵Fédération française de badminton, christophe.hausswirth@wanadoo.fr

The aim of the present study was to compare two incremental tests (track run vs. badminton) in terms of heart rate (HR) and lactatemia (La) recorded during and after the different tests. Experiments as a whole were conducted on high-level badminton players. HR values were recorded on 9 players during the tests. Oxygen uptake ($\dot{V}O_{2max}$) values and the ventilatory threshold (V_T) were determined after the track running test. During the both testing procedure of short duration (8-9 minutes), the level of the exercise was increased each 30 seconds (e.g. 0,5 km.h⁻¹ each 30 seconds in running) until exhaustion. Results revealed no difference in total duration of exercise but showed a high correlation ($P<0.01$) between the badminton test and the world ranking of the players. In other respects, this result was not determined for the running test; we conclude that the badminton test was more accurate than a classic running test for badminton high-level players. This activity should linked many specific ways of moving on the court including characteristics jumps which reflects a particular locomotion.

The purpose of this paper is to show how the concept of performance diagnosis by mathematical simulation (Lames 1991; Perl, 1993) can be transferred to table tennis. According to that concept, the series of the interactive game actions (e.g. serve, return, offense, defense, and so on) can be described by means of a statistical transition matrix between the different states of action. After the series of the game actions is modeled by a Markov chain, the relevance of each game action for the final win or loss of the game can be simulated.

Method: 152 matches of the top 50 male world class players were assessed. For the match analysis the sample was divided into four groups: shakehand vs. shakehand play, shakehand vs. penholder player, penholder vs. shakehand player, and penholder vs. penholder player. The game observations included the categories (1) game action, (2) stroke position, (3) stroke direction, and (4) stroke technique.

The objectivity of the game observation system was determined by the common variance between the results of two independent observers, and Cohen's kappa.

Results: the common variance between the results of the two observers varied between 91.9 percent ($r_{\text{obj}} = .96$) for the stroke technique, and 97.4 percent ($r_{\text{obj}} = .99$) for the stroke position. Cohen's kappa varied between .91 (technique) and .97 (stroke position). The correlation coefficients between the observed and the mathematically modeled point probabilities for the four game observation categories varied between $r = .998$ and $r = .999$ ($p < 0.001$), which proved the validity of the Markov model.

The simulation procedures showed that the neutral play actions have a particular relevance for the game success in elite table tennis. When the transition rates from the neutral game actions of one player to the defense action of the opponent were raised only by a small amount, then the probability of winning the game was highly increased compared to the other game actions ($F = 121.33$; $p < 0.001$). The relevance of stroke faults was nearly the same in the forehand and the backhand position. Only in the case when penholder competed with shakehand players, stroke faults showed a higher performance relevance in the forehand of the penholder players ($F = 5.00$; $p < 0.001$). Among the different stroke directions, a strike from the long backhand side to the long backhand side of the opponent was most successful ($F = 89.56$; $p < 0.001$). Especially in shakehand players, the topspin showed the highest relevance of all techniques for the win of the match ($F = 8.07$; $p < 0.001$).

Discussion: the results show that the performance diagnosis on the basis of the mathematical simulation of success probability by means of the Markov-chain model is a worthwhile procedure in table tennis. An advantage of the Markov procedure is that the model explicitly represents the interaction between both opponents when calculating the relevance of each game action.

Studying the difference in play patterns from recreational to elite players can provide useful results that can be coached back to developing female badminton players to improve their game.

'Developing players' can be given feedback about the tactics of other standards of players to aid them in improving their own tactics, and elite players can gain specific feedback highlighting their opponents' game strategies, strengths and weaknesses.

The purpose of this study was to compare patterns of play between elite ($n = 10$ matches), county ($n = 10$) and recreational ($n = 10$) badminton players. The data collected used ladies singles badminton players from the 1997 Bath Open and 1999 Welsh Open, South Wales county competitions and local known recreational players.

A hand-notation system was used to analyse the data by means of post-event notational analysis. The court was divided into eighteen cells (nine cells each side of the net) to analyse the position of each shot. The shots were identified as two types of serve and nine shots that occurred in open play. Rally and match lengths, and winners and errors were also examined. For reliability study, a game from an elite match was analysed 3 times with more than a week between each set of data gathering. Percentage error calculations and χ^2 tests for comparisons of distributions showed that the largest differences were less than 2%, and that there were no significant differences ($P < 0.001$; $\chi^2 = 0.15$). Establishment of normative profiles was carefully explored, for example a normative profile, within a 5% limit of error, was established for elite players after 7 matches when analysing mean error values, and 4 matches when studying mean winner values. After 4 matches the mean error values for county players stabilised with a normative profile set within 10% limits of error but there was no normalisation of the recreational data for mean winner and error values.

Chi-square tests were used to determine whether the frequency distributions of selected variables showed significant differences, and a Kruskal-Wallis test looked for significant differences for mean shots per rally. It was found that there was no significant difference ($P < 0.01$) between all three playing standards for the parameter 'shots per rally'. Significant differences ($P < 0.01$) were found amongst the variables, 'frequency of shots per match', 'frequency of rallies per match', 'frequency of winners per match' and 'frequency of errors per match' when elite players were compared with county and recreational players. With the exception of the variable 'frequency of shots per match', there were no significant differences ($P < 0.01$) found for the above stated variables when county players were compared with recreational players.

It was concluded that the elite players used their tactical knowledge, technical ability and physical fitness as a means of employing the most effective playing patterns. The county players displayed developing playing patterns whereas the recreational players lacked the tactical knowledge and technical ability to produce a skilled performance.

Anticipating serve direction: implicit sequence learning in tennis

R.C. Jackson and M. Gudgeon

*Department of Sport Sciences, Brunel University, Uxbridge, Middlesex, UB8 3PH, UK,
Robin.Jackson@brunel.ac.uk*

One of the skills that separates experts from their less skilled counterparts is the ability to anticipate key events. Research has established that experts display greater sensitivity to advance postural cues, and also make greater use of situational probabilities and contextual game-related information than novices (Williams & Grant, 1999, *International Journal of Sport Psychology*, 30, 194-220). Currently, there is a debate over how such skills are learned and hence how they should be coached. Specifically, it has been suggested that anticipation may largely be learned implicitly, that is, experts may become sensitive to subtle postural cues or situational probabilities without necessarily intending to do so and in such a way that the resulting knowledge is difficult to express (Berry & Dienes, *Implicit Learning: Theoretical and empirical issues*, 1993, Hove: Lawrence Erlbaum Associates). Thus far, there is no clear evidence of implicit learning in the anticipation literature, therefore, the aim of the present study was to examine whether implicit learning of a serve location sequence would occur in tennis players.

Eleven male tennis players ($n = 5$ coaches, $n = 6$ club players) each returned 108 serves using a modified alternating serial reaction time task. This paradigm requires the participant to react as quickly as possible to a stimulus, such as the position of a light or in this case the direction of the serve. Unbeknownst to the participant, trials alternate between those following a pre-determined sequence and those in which location is randomly determined. A difference between reaction times in the random and sequence trials in the absence of explicit knowledge of the existence of a sequence constitutes evidence for implicit learning. Nine blocks of 12 serves were directed towards one of three locations in the left service box (down the middle, into the body, out wide) alternating between 'first' and 'second' serves. Each trial was recorded using a 50Hz video camera located behind the receiver, for whom reaction time was subsequently determined by counting the number of frames from when the server struck the ball to the moment the receiver initiated movement to facilitate a return. Explicit knowledge of the sequence was determined both by an open-ended question and forced-choice prediction task.

Results revealed a significant interaction between serve sequence and player ability. Specifically, a significant difference in reaction time between random and sequenced serves was apparent in the club players but not the coaches. Evidence for sequence learning in the club players being implicit was apparent in the tests of explicit knowledge which revealed that none of the participants were aware of the presence of a repeating sequence. This was backed up by the prediction test, in which they correctly reported a mean of 1.5 of the 6 locations, below chance level.

These results suggest that a sequence can be learned implicitly, resulting in faster reaction times and a potential advantage to the receiver in tennis. Additional research is required to determine the reasons for the lack of implicit sequence learning in the coaches. Anticipation involves both explicit and implicit processes and determining the way in which these interact represents a significant challenge for those conducting research in this area.

The disguise and deception of an international level squash player.

N. James, C. Bradley and S. Mellalieu
University of Wales Swansea, Singleton Park, Swansea, SA2 8PP, UK. N.James@swansea.ac.uk

It has been suggested that it is tactically significant to be able to anticipate ball trajectories (Féry and Crognier, 2001, *Research Quarterly for Exercise and Sport*, 72(2), 143-149). Experts have consistently been shown to possess a significant advantage over less skilled players in utilising the advance visual cues e.g. racket and arm, thought to enable superior performance in anticipating ball trajectories e.g. James and Holley, 2002, *Journal of Sports Sciences*, 20(1), 65-66. This has usually been examined in artificial environments e.g. subjects watch a video recording of a performance viewed from the perspective of a performer as opposed to more ecologically valid real world studies. Whilst an expert advantage has been shown in this regard little is known about the actual cues used or how these may differ in for example different strokes. Temporal occlusion studies (stopping the action prior to the ball being struck) cannot provide any useful information with regard the nature of the cues and so other methodological approaches have been used, either spatial occlusion (hiding certain parts of the display) or eye movement registration (tracking the parts of the display fixated upon). These studies have been limited to yielding information about body parts thought useful as visual cues.

A case study used a male world ranked squash player (number 15 during data capture, but previously ranked in the top 5 for 1 year, mainly in 2001). A high speed camera (Motionscope PCI 1000S, Redlake Imaging Corporation) captured real event (a match versus a player ranked 70 in the world) and training scenarios at 250 frames per second. The camera operates through a PCI card in a PC such that just over 4 seconds of play (1024 frames) are continuously recorded. The trigger to transfer the images from memory to hard disk was set to record the 4 seconds of play prior to trigger activation. This was important because only relatively easy shots were to be analysed (to make the likelihood of deception being used greater). In the match situation the player was asked to play as he normally would. In the training situation the ball was fed to the player (short to the forehand from deep) who was instructed to play different shots, as he would during a match, but to actively try to disguise his intentions. The captured data was analysed using biomechanical video analysis software (Quintic Consultancy Ltd.). Accurate timings of ball bounce, racket swing and point of ball contact as well as synchronised images (to ball contact and ball bounce on floor) of the player hitting different strokes were produced (to aid analysis).

Analyses showed that the ball was hit between 0.24 s and 0.63 s after the ball bounced on the floor (across both conditions). This was in part due to the previous shot i.e. pace of ball (in the match situation) but was under the control of the player. This appeared to be a strategy employed to try to deceive the opponent i.e. to hit the ball early or late although these differences were very small. There was no significant difference ($p = 0.19$) between the time of the ball bounce and the ball being hit when comparing straight shots (0.38 ± 0.03 s) and cross court shots (0.47 ± 0.14 s (mean \pm SD)). When similar shots were played during the training scenario (off similar ball velocities) the ball was struck at very consistent time delays after the ball bounce e.g. straight drop shots were between 0.25 and 0.24s. This very small variation may be indicative of the player intentionally delaying the shot. The swing characteristics of the racket (when playing either straight, crosscourt or short) was judged to be remarkably similar (the first author is a level 4 squash coach and previous National squad coach). Clear differences only became apparent between 0.07s and 0.03s before ball contact. This difference was as a result of differing wrist angles employed to play the shot of choice at the last moment and is clearly a sign of excellent technique. The results suggest that a combination of disguise (very similar stroke patterns for different shots) and deception (playing the ball deliberately early or late) characterised this elite squash performance when playing relatively easy shots. Opponents should avoid trying to make early judgements (> 0.07 s prior to ball contact) regarding shot direction against this player. Future research needs to consider relative timings to assess the efficacy of visual cues and their actual usage.

Jin Xing, Tang Jianjun and Wu Fei,

Small ball teaching and research, Beijing Sports University, Beijing, 100084, China, xing19820604@yahoo.com

The requirement of stamina of table tennis athletes are greatly enhanced with the use of 40mm ball. In order to make coach direct training more better, this paper researches energy metabolism of Chinese table tennis athletes. Accordingly, we put forward some related methods. In this paper we mainly use documents and logical derivation to study.

After the consideration, we can reach conclusions. First, it is a kind of endurance events, and its mean value of intensity is lower. Second, in this sport aerobic oxidation and anaerobic oxidation go on alternately, but most of that is the former. The longer time it lasts the more energy is supplied by fat. The load of table tennis sport is low not because of the short time but rest-moderate load-short big intensity changes continuously. When the athlete is playing, its energy is usually depends on anaerobic-nonlactic acid. About two thirds of the competition is constant repetitious rest, and its energy is provided by aerobic oxidation which can recover the temporary reduced muscular and phosphoric acid. With regard to different style of ping-pong players, consumption of energy is a little different. Looping and attacking style players consume more energy than chopping style players. Meanwhile, the mode of consumption is also not as the same. Generally, the proportion of anaerobic oxidation exists more in attacking style players. This is because, during the competition, the pace and frequency of hitting are higher in attacking style players than in chopping style players.

So, when coaches arrange body training, the content must be in accordance with the characteristics of the energy supply. For example, then can ask their students to train in very short time(5-10 s) to reach extreme. In order to increase the ability of aerobic oxidation, they also can last a long time, but they must pay attention to the interval.(The interval must be identical to the competitor almost)

L. Jospin and V. Fayt

Laboratoire d'Analyse Multidisciplinaire des Pratiques sportives (LAMAPS), UFRSTAPS de Liévin, University of Artois, France, vfayt@nordnet.fr

Introduction

During matches, an experienced table tennis player show a high level of performance and of efficiency, allowing him to answer to multiple needs of this sport (Guthrie, 1952, The Psychology of Learning, New York : Harper et Row, p.136). Despite this fact, few studies deal with both of these characteristics and their evolution during training (Famose, 1990, Apprentissage moteur et difficulté de la tâche, INSEP, p.181). The goal of this study is to show that performance (% of success) and efficiency (heart rate at the end of the exercise, HR_{Exo}), achieving three tasks with incremental constraints, depend on players practice level.

Method

21 players, divided into 3 groups based on their federal classification (National, Regional and Not Classified), execute three tasks of increasing difficulty : a series of forehand drives (FH) without lateral movements (T1); a series of FH and backhand (BH) with lateral movements (T2); same situation as in T2 combined with the constraint of hitting a 21 cm diameter target (T3). All the tasks are performed during 60 seconds with a 60 balls per minute rate. HR_{Exo} is measured through a cardiofrequencemeter (Polar Accurex Plus). ANOVA tests with factors Practice Level and Test, with repeated measures on Test, were carried out on the % of success and on HR_{Exo}.

Main results

As concerning performance, a significant main effect is found for Practice Level (66% National versus 52% Regional and 46% Not Classified; $F_{(2,36)}=12,845$, $p<0.0001$) and Test (61% for T1 and T2 versus 37% for T3; $F_{(2,36)}=73,974$, $p<0.0001$) factors. ANOVA on HR_{Exo} revealed a significant main effect for Test factor (T1 = 146 bpm, versus T2 = 165 bpm, and T3 = 170 bpm; $F_{(2,36)}=31,966$, $p<0.0001$) while Practice Level factor doesn't show to be significant ($p=ns$).

Conclusion

Results reveal that, maintaining an equivalent level of efficiency (HR_{Exo} doesn't change with Practice Level), training leads table tennis players to a higher level of performance (experts show a higher level of performance than other players). The unchanged HR_{Exo} between T2 and T3 could be explained through the use of "diverted" strategies by Regional and Not Classified players. These strategies allow to reduce energetic implication level of players faced with velocity and accuracy constraints. Simplified tasks strategies, in terms of action on the ball and body shifts, are associated with compensatory movements typical at lower practice level players. This study reveals an interesting way for trainers to obtain reliable indicators, allowing them to establish an evolution in training exercises based on balls frequency suited to players practice level.

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Is there any interest to measure metabolic parameters in racket sports?

E. Jousselein

National Institute of Sport and Physical Education (INSEP), Medical Department, 11 avenue du Tremblay, 75012 Paris, France, eric.jousselein@insep.fr

The measurement of metabolic parameters (VO_2 max, anaerobic threshold, maximal aerobic power or maximal speed aerobic...) was popular in the 1980's. But most of trainers were disappointed by the relationship between these energetical parameters and the performance in specific sports.

However, since few years, athletic trainers help the specific trainers to enhance the performance. And on the other hand, the French law about high level sport (1999) indicates a metabolic exploration must be done, one to three times per year, on each of these high level athletes.

We present and discuss about these parameters in three racket sports - tennis, table tennis, badminton - in men and women above and under twenty years old.

Impact prediction between a ball and racket in terms of contact forces, contact times, restitution coefficients and the feel in table tennis

Y. Kawazoe and D. Suzuki

Saitama Institute of Technology, 1690, Okabe, Saitama, 369-0293, JAPAN, ykawazoe@sit.ac.jp

At the current stage, very specific designs are targeted to match the physical and technical levels of each player. However, the ball-and-racket impact in table tennis is an instantaneous phenomenon, complicated by the involvement of a human. Many unknown factors are involved in the mechanisms that explain how the specifications and physical properties of the racket and the ball influence the racket capabilities.

This work investigated the physical properties of the racket and the ball in table tennis, and predicts the impact force, the contact time, the deformation of ball and rubber, the coefficient of restitution, and the rebound power coefficient associated with the impact when the impact velocity and the impact location on the racket face are given. It clarifies the origin of ball speed. It is based on the experimental identification of the dynamic characteristics of the ball-racket system and an approximate nonlinear impact analysis, where the contact time is determined by the natural period of the whole system composed of the mass of the ball, the nonlinear stiffness of the ball and rubber, and the reduced mass of the racket at the impact location on the racket face considering the hand-held condition. Also considered are the energy loss and the feel at the grip portion due to vibrations of the racket during the impact.

This work enables us to predict quantitatively the factors associated with impact between a racket and a ball in table tennis. The result showed that the rebound power coefficient peaks at 16 cm from the grip end of the racket and then diminishes because of the mass distribution of the racket where the diameter and the mass of the ball are 38 mm and 2.5 g respectively and the mass of the racket is 171 g including 79.5 g for two sheets of rubbers. The rebound power coefficient decreases remarkably with increasing impact velocity. It also found the interesting fact that the player's arm gives a remarkable effect on the reduced mass of racket but it does not give an effect on the rebound ball velocity because the ball is too small compared to the racket in mass.

The vibration amplitudes of several mode components of a table tennis racket with rubbers were also predicted when a ball hits a racket at any impact locations with any impact velocities using the performance prediction system developed in this study. It seems that the 1st mode vibration component might play an important role for a play and a player might be able to identify the impact location on the racket face using the magnitude of vibrations at the grip portion.

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Y. Kawazoe and D. Suzuki

Saitama Institute of Technology, 1690, Okabe, Saitama, 369-0293, JAPAN, ykawa@sit.ac.jp

This work has compared the new larger 40 mm ball with the 38 mm ball in terms of the impact force, the contact time, the deformation of the ball and rubber, the coefficient of restitution, the rebound power coefficient and the vibrations associated with the impact between the hand-held table tennis racket and the ball when the impact velocity and the impact locations on the racket face are given. It is based on the predicted results with the experimentally identified dynamic characteristics of the ball-racket system and the approximate nonlinear impact analysis. The contact time is determined by the natural period of the whole system comprising of the mass of the ball, the nonlinear stiffness of the ball and rubber, and the reduced mass of the racket at the impact location on the racket face considering the hand-held condition. It also considers the energy loss during impact between the ball and the rubber.

The predicted racket performances regarding the rebound power of a 40 mm ball (2.7 g) were compared to those of a 38 mm ball (2.5 g) using a racket with mass of 171 g including 79.5 g of the rubbers. With the 40 mm ball compared to the 38 mm ball, the impact force is slightly larger, the contact time is shorter below 15 m/s and longer above 15 m/s of impact velocity, the deformation of the ball is much larger but that of the rubber is almost the same, and the rebound power coefficient is slightly larger below 20 m/s but smaller above 20 m/s of impact velocity. Accordingly the post-impact velocity of the 40 mm ball is slightly faster below 20 m/s of impact velocity and slower above 20 m/s compared with those of the 38 mm ball. Since the drag force of 40 mm ball should be larger than that of 38 mm ball, the velocity of 40 mm ball should be slower.

The reason that the contact time is shorter below 15 m/s and longer above 15 m/s of impact velocity and the rebound power coefficient is slightly larger below 20 m/s but smaller above 20 m/s of impact velocity with the 40 mm ball than those with 38 mm ball is due to the experimental fact that the stiffness of the composed rubber/ball system is larger, the energy loss of the ball and the rubber during impact is also larger and the deformation of rubbers are larger at the lower impact velocities and smaller at the higher impact velocities with the 40 mm ball than those with 38 mm ball.

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Y. Kawazoe¹ and R. Tanahashi²

¹ Saitama Institute of Technology, 1690 Fusaiji, Okabe, Saitama, Japan, ykawazoe@sit.ac.jp
² Tanahashi Applied Research Laboratory, Hamamatsu, Japan

At the current stage, the terms used in describing the performance of a tennis racket are based on the feel of an experienced tester or a player. However, the optimum racket depends on the physical and technical levels of each user. Accordingly, there are many unknowns regarding the relationship between the performance estimated by a player and the physical properties of a tennis racket. This paper investigates the physical properties of a conventional weight racket and a light weight racket with oversized heads, predicting racket performance in terms of the coefficient of restitution, the rebound power coefficient, and the post-impact ball velocity, that is the performance relevant to the power of the racket.

It is based on the experimental identification of the dynamics of ball-racket-arm system and the approximate nonlinear impact analysis with a simple groundstroke swing model.

The result of the comparison between the two oversized rackets showed that the restitution coefficient and the power or post-impact velocity of a ball of a light weight racket are larger than that of a conventional weight racket. However, it also showed that the post-impact ball velocity of the former is lower than that of the latter when a player hit the ball off the longitudinal axis of the racket head. Furthermore, the rebound power coefficient of a light weight racket is lower than that of a conventional weight racket. The predicted results could explain well the mechanism of difference in performance between the conventional weight and the light weight racket with oversized heads.

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A comparison of the feel or comfort of light weight racket and conventional weight racket with oversized heads based on the predicted tennis impact

Y. Kawazoe¹ and R. Tanahashi²

¹ Saitama Institute of Technology, 1690 Fusajiri, Okabe, Saitama, Japan, ykawa@sit.ac.jp

² Tanahashi Applied Research Laboratory, Hamamatsu, Japan

At the current stage, the terms used in describing the performance of a tennis racket are based on the feel of an experienced tester or a player. However, the optimum racket depends on the physical and technical levels of each user. Accordingly, there are many unknowns regarding the relationship between the performance estimated by a player and the physical properties of a tennis racket. This paper investigates the physical properties of a conventional weight racket and a light weight racket with oversized heads, predicting racket performance in terms of the feel or comfort at the wrist joint of a player.

It is based on the experimental identification of the dynamics of ball-racket-arm system and the approximate nonlinear impact analysis with a simple groundstroke swing model.

The predicted results could explain well the mechanism of difference in performance between the conventional weight and the light weight racket with oversized heads. Although the result of the comparison between the two super-large sized rackets (120 in²) showed that the shock vibrations of the super-light racket is much larger than that of the conventional weight racket according to the authors' previous paper, the result of the comparison between the two oversized rackets (110 in²) showed that the shock vibration of the light weight racket is smaller during impact and has a wider sweet area in terms of the feel than the conventional weight racket.

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Dehydration and performance during prolonged, intermittent table tennis bouts at high ambient temperature

Y. Kobayashi¹, T. Takeuchi¹, T. Hosoi¹ and S. Takaba²

¹ School of Arts and Sciences, Chukyo University, Showa, Nagoya 466-8666, ² School of Pharmacy, Meijo University, Tempaku, Nagoya 468-8503, JAPAN, ykobayas@lets.chukyo-u.ac.jp

Table tennis has recently been considered as an attractive leisure time activity to combat inactivity and the risk of associated diseases. It is a convenient, moderate intensity exercise, but often played in facilities not adequate to prevent seasonal heat stress. This study compared cardiovascular and thermoregulatory stress during prolonged, simulated intermittent table tennis bouts (8 X 10-min bouts with 3-min rest intervals) at high ambient temperatures (30°C, 70% RH) with (H_F) and without (H₀) fluid intake and at a moderate environment (M₀: 17°C, 50% RH). Eight 20-yr old competitive table tennis players were matched in the 3 environmental conditions against a robot that delivered 60 balls per min. The graded performance task was to return the ball to a target area on the distal end of the table which was 1/8 the table area. Before and during rest periods in H_F the subjects drank a commercial sport drink (6.7% glucose, 21 mEq/L Na⁺) *ad libitum*. Rectal temperature (T_{re}; Fig. 1) and heart rate (HR) were significantly higher (p<0.01) during H₀ than H_F, but T_{re} and HR were not different between H_F and M₀. Midway through the trials (50 min) and after the last bout (100 min) during H₀, the plasma volume was markedly reduced by 6.5% which was significantly more than the 3% decline during H_F and M₀. During H₀ the plasma osmolality increased significantly more than during H_F and M₀. The intake of the carbohydrate-electrolyte fluid during H_F did not significantly affect plasma lactate, but reduced free fatty acid and increased glucose blood levels. The fluid intake was effective in maintaining physical performance, in that the significant deteriorations in anaerobic power (jump test) and table tennis performance score during H₀ were prevented during H_F and values were similar to those during M₀ (Fig. 2). The reduced table tennis performance and anaerobic power tests during H₀ were closely associated with elevated T_{re}, HR and plasma volume loss, all attenuated by the fluid intake. The precise mechanism by which the fine motor performance decrement was brought about during H₀ is unclear. However, the study shows that fluid intake during prolonged, moderate exercise is important to maintain fine motor performance by skilled players. Also, because table tennis has increased in popularity as a recreational activity for fitness and health, adequate fluid intake at high temperatures may also prevent medical complications in unfit individuals.

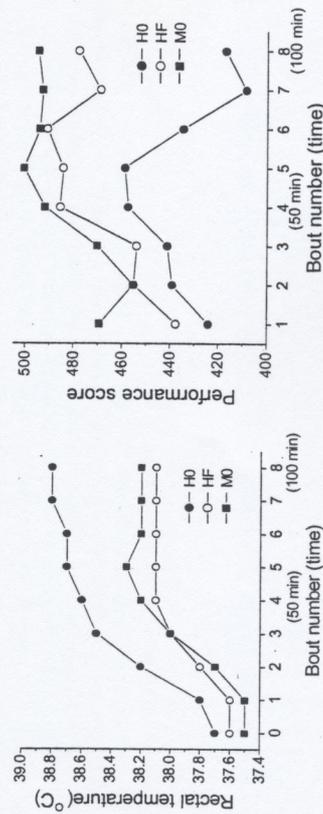


Fig. 1. Rectal temperature vs. time

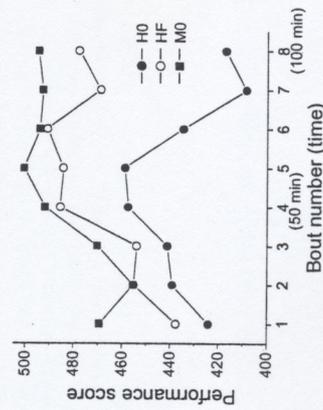


Fig. 2. Performance score vs. time

Myoelectric and neuromuscular measures of forehand strike in table tennis executed with balls of two different sizes

M. K. Kondrić¹, G. Fujić-Mandić² and V. Medved²

¹*Faculty of Sport, University of Ljubljana, Slovenia, Miran.Kondric@sp.uni-lj.si*

²*Faculty of Kinesiology, University of Zagreb, Croatia*

In Kuala Lumpur, where the International Table Tennis Federation announced the replacement of the 38 mm ball with the 40 mm ball, it became evident that with decreased ball speed and rotation the players would have to devote more time to physical preparation. The difference between the physically better prepared players and the less prepared ones became apparent at the World Championships in Osaka. At the first World Championships played with the larger ball, the number of strikes per rally increased, which means that matches became longer and more demanding.

Taking into account the strains of a two-week competition, it turned out that physical preparation, in particular additional strengthening of the shoulders area, would become a crucial factor of success. However, to design optimal physical preparation for table tennis players, it is essential to establish exactly which muscles of the shoulders area work harder due to the new ball. In our study, we tried to measure how much do mioelectric and neuromuscular impulses during forehand strike differ between using the 38 mm and the 40 mm ball. We analysed contraction of the muscles that are primarily involved in the forehand attack: m. pectoralis, m. deltoideus, m. biceps brachii, m. transversus abdominis and m. latissimus. The measurements were taken on a professional table tennis player. Strength as well as duration of contractions of the abovementioned muscles was measured. The data were gathered and analysed both visually and quantitatively.

The obtained measurements and graphical displays from the experiment indicate that in general, there is a minor difference in operation of the studied muscles between forehand attack strike using 38 mm and 40 mm ball.

Pelota : a « racket sport » unlike any other

G. Laporte

Fédération française de pelote basque, 60 avenue Dubroq, Trinquet Moderne, BP 816, 64108 Bayonne Cedex, France,

Apart from its cultural connotation, pelotais exceptional as a ball sport. It includes a variety of different games that use a ball but which can call on different supports, whether of the racket type (as in frontennis), of glove (as in the famous basketlike chistera), of pala, or simply the bare hand like in traditional handball. So that all in all, there are actually more than 20 different types of pelota, even though in official international championships only 14 different categories are recognised.

The balls themselves can vary too. They can come in solid rubber or covered in leather.

The different games are also played in different types of alleys, whether the outdoor alley (or « fronton place libre »), or the three indoor types of alley: « trinquet » (4 wall alley), « mur a gauche (3 wall alley) which include a shorter version and a longer version (called in Basque « jai alai »).

While these different varieties of the game require the same athletic qualities in moving and hitting the projectile, there are distinct variations for each specialty and each has its own consequences on the preparation required for the player.

The same applies to pathology types which will be seen to be shared with any other racket sport. But pelota can also occasion accidents to the skull and eyes, not to mention such inherent pathologies peculiar to this sport alone, in the handball variety for example, what is called the « nail syndrome », as well as Raynaud's syndrome and hemoglobinuria, which take much research in order to find a cure and above all preventive treatment.

There are presently a dozen categories of this racket sport run by the French Federation of Basque Pelote assisted by its team of consulting doctors. For the newcomer to the sport, all this variety may appear perplexing. But to the amateur, this is all part of the charm.

Research on the rule of score change in the 11 score game

Liu Dong-Hua¹ and Dong Yang²

¹The Physical Education research institute of Shang Hai Jiao Tong University 200030
situsports@mail.sjtu.edu.cn, ²Harbin Engineering University, Harbin 150006 China

1. Purpose

We can find through the 55 sets in our country and overseas excellent table-tennis players: the key score, key set, keep ahead or drop behind has different change between the 11 score and the 21 score game. So we must assimilate the strongpoint in the 21 score game is the base and the assure to adapt the 11 score game.

2. Method

materials method, questionnaire investigate, expert investigate, compare method, mathematics statistical, logical analyze

3. Result

3.1 If player won the first set, it has 75 percent games would be win in the competition. In 9 games, the player wouldn't appeared fluctuate in mentality when him (her) won the first set, and 90 percent will get victory.

The 11 score game is shorten the competitive time, reduce the score and shorten the distance of players. It makes the chance for low-level player to get victory in competition. So win the first set is most important. Especially, when the competition is between the same level, him (her) must be "change and fency".

3.2 If player won the third set, it has 90 percent games would be win in the competition. The 11 score game is shorten the competitive time, reduce the score and increase the mentality press. So the player must have better adjust psychology ability. Through the analyze we can conclude that the third set is the key set in the competition. If the player win the third set, him (her) will give the advantage in the competition.

3.3 Keep ahead in the third set, the players were all get victory in the 8 games. We considered that the competitive is depended on player's level. But the 11 score game is shorten the level of players. If the player adopted good technique and tactics, him (her) will get victory in the competition.

3.4 The connection between keep ahead and drop behind
If our country player was keep ahead get the sixth score in per set, it total 18 wins and 7 defeats, 72 percent win the match.
If our country player was drop behind get the sixth score in per set, it total 7 wins and 8 defeats, 46 percent win the match.

The 11 score game is require the player must enter the match as quickly as he can. Every set is very impetuosities, tensely and has many key score in the 11 score game. Although our women players' level is better than other countries players' in the 21 score game, but we haven't advantage in the 11 score game.

We must noticed that it is very difficult to pull up to leader when the player is drop behind 4 score in the 11 score game. The data tell us that our country players keep ahead 4 score together 12 sets, 9 wins and 3 defeats, 75 percent win the match, and keep ahead over 5 score, 16 wins and 1 defeats. we can find that the most different between the 11 score game and the 21 score game is less score and more tensely. So we must attach importance to every set, every score, the counterattack ability, better technique and tactics.

4. Conclusion

The rule of score change in the 11 score game: the key is the sixth score, the first set, the third set. We must search the technique and tactics to adapt this rule in training and enhance the quality of training.

A probe into knife grip play with forehand inward pimped rubber and backhand outward pimped rubber in table tennis

Liu Gang

ShenZhen Tianxin School, Guangdong Province, People's Republic of China 518081,
liti-888@163.com

At present, most of the elite table tennis players use either knife grip play with two-side loop or penhold grip with one-side outward pimped rubber and one-side inward pimped rubber. Due to the increase of the ball diameter, which was ratified by the International Table Tennis Federation, speed of the ball becomes slower and spin becomes weaker, thus, the menace of loop reduces, and the player will be in the passive state. In the view of these facts, it is the key problem how players maintain the menace of loop and increase the speed so that the player can always take the initiative in the competitions.

Results : based on the statistics on the rate of utilities, rate of points at rally, passive rate of points and initiative rate of points at the different counts of forehand and pivot, we know that : (1) in the whole contrast with Waldner (Sweden) and Liu GuoLiang (China), WangTao (China) shows the characteristics of skills as a whole and no difference among them. Whereas, both Wang Tao and Liu GuoLiang show the characteristics of the prominent single skill; (2)Wang Tao has an obvious advantage in passive attack, especially in the backhand court. By the contrast between Waldner and Wang Tao, we know Wang Tao's superiority mainly lies in the changes of backhand outward pimped rubber in passive attack, and it is the changes that make it difficult for the opponents to judge the ball quickly, which leads to the faults. The main difference between knife grip and penhold grip lies in the backhand court. Due to physiological limit, penhold backhand is influenced by elbow so that the action of whip can't be done; (3)Wang Tao has a big advantage in attacking and defence rally. By the contrast between penhold grip and knife grip, we find that knife grip play with forehand pimplesandwich rubber and backhand outward pimped rubber has obvious superiority in either the changes or the rhythm. If two players level is nearly equal, attacking and defence at rally is the key for them to win the game. With the rapid development of table tennis skills, the player can come out first as long as different skills are developed as a whole except to have a good command of initiative attack.

Conclustions and suggestions : by the contrast with Waldner, we find that knife grip play with forehand pimplesandwich rubber and backhand outward pimped rubber increases the attacking menace, the ability of attacking and defence rally and the quality of countering. By the contrast with Liu Guoliang, we know that play shows the best combination of skills and body functions, and it can give the rein to the player's greater potential; every play has its own weaknesses, and the more quickly the play develops, and the more fierce it is, and the more changes it has, the more advanced it is. We believe that the player whose play is knife grip with forehand pimple sandwich rubber and backhand outward pimped rubber will obtain excellent performance in the table tennis competitions.

Liu Qing-Guang and Gu Sheng-Yi

*The Physical Education research institute of Shang Hai Jiao Tong University 200030
situsports@mail.sjtu.edu.cn*

Rong Guotuan won the 1st gold medal for China in 1959. Since then, China table tennis team has attended 4 Olympic Games, winning 13 gold medals. It also joined in 18 World Table Tennis Tournaments, achieving 89.5 champions. By adding 21 World Cup champions, this team has got altogether 123.5 world champions, covering 33.7% of the total number. In this passage, based on the former study results and present documents, as well as series of visits and investigations on technical and tactical theory innovation, I am intended to conduct a research of comparison, thus summarizing its innovation laws to further perfect relevant theories.

Study objects : set the world table tennis as a frame of reference, including China, Sweden, Japan, Germany and Korea. I put emphasis on Chinese and foreign table tennis technical and tactical theories, practice and its development laws.

Discussion and analysis : according to the results, 82% coaches and experts think that the number of professional table tennis terms more or less reflect a certain country's mastery of tactical laws, while the rest think that it only reflects parts of the real condition. Our study purpose is to contrast the Chinese and foreign terms, and the study scope covers all present documents at home and abroad which have specialized explanations toward the terms.

There are 842 Chinese theoretical terms, occupying 77% of the total number. Because the inevitable repetition, the actual number is less than 252. That's to say, their cognition on table tennis terms is only limited to basic theoretical knowledge. The number of Chinese technical terms is up to 323,71 more than all the 252 foreign terms. Our technical terms account for 38.4% of all Chinese terms, while the 16 technical terms cover only 6% of all their terms. We have 20 times the number of foreign technical terms. This fact tells us that our studies include almost all about table tennis techniques, which not only grants us adequate theoretical and substantial foundations, but also a better understanding of techniques devoted to the comprehension of table tennis intrinsic laws. Furthermore, we divided all the terms into 3 kinds: serving terms, single technical terms and combined technical terms. The reference documents show that there are 75 serving terms, accounting for 97%, 97 single technical terms, occupying 87% and 151 combined technical terms while there exists no such relevant foreign terms until now.

Conclusions : (1) We boast far more table tennis terms than foreign countries, which prove our advanced cognition and on the intrinsic laws of this event and better mastery of basic theory. All these lay a solid theoretical foundation for our future innovation. (2) Technique is the core of improving comprehensive power. The key of innovation and development is to improve the level of single factor and combined level between factors. The continuity of our technical innovation and stability of four technical development are both one step further than that of the rest of the world, providing effective support for our future prosperity. (3) China is leading the world table tennis innovation. Only by seizing the actual meaning of innovation, fully combining theoretical creation and practice, correctly realizing the rationality and feasibility of innovation, constantly perfecting technical and tactical styles, persevering in innovation, will we be able to pour more vitality into table tennis development all over the world.

Z. Major and R. W. Lang

*Institute of Materials Science and Testing of Plastics, University of Leoben, Franz Josef Strasse 18,
A-8700 Leoben, Austria, major@unileoben.ac.at*

In table tennis recently complex racket designs are used consisting of a wooden or glass or carbon fiber reinforced racket frame with multi-layer rubber/foam covers with special top surface properties. Various rubber compounds and glues (adhesives) are applied in the build up of the multi-layer rubber foam cover to impart greater spin or speed (up to 160 km/h) onto the celluloid ball. In terms of material characteristics, important aspects of a successful table tennis racket design are related to the elasticity and damping of the entire sandwich system and the specific surface properties that generate the spin of the celluloid ball upon the impact contact with the rubber surface.

All of the above polymeric materials involved in a racket design reveal a distinct viscoelastic behavior, which implies that their elastic, damping and surface properties depend on time (loading rate or frequency, aging) and loading level. Despite the high interest of applying scientific concepts to table tennis, there is currently no widely accepted methodology available to characterize and to determine the performance profile of table tennis rackets as a whole or of individual or combined polymeric material layers in terms of their viscoelastic properties and property functions. The objective of this study is the systematic characterization of performance properties of table tennis sandwich rubbers consisting of specific rubber cover sheets (pimpled-in and pimple-out) and sponge (cellular) rubbers under various loading conditions using polymer science based test methods. The experimental work involved various table tennis sandwich rubber types from different producers with different thicknesses. New and used material sheets were tested as full size specimens (racket size) and as sub-size specimens (circular discs with a diameter of 34 mm). Monotonic uniaxial compression tests were performed over a wide loading rate range to characterize the bulk behavior of the rubbers. Cyclic (dynamic) characterization tests were performed under compression over a frequency range of 1 to 200 Hz to determine the frequency dependence of the complex dynamic modulus E^* , the visco-elastic damping, $\tan \delta$, the storage and the loss energy components and the frequency response functions (transmissibility). All of the above tests were performed at room temperature (23 °C) and at 50% relative humidity using a high rate servohydraulic test system.

The results of this investigation are discussed in terms of loading rate and frequency dependent material property functions. Furthermore, a material science based methodology is proposed for the ranking and classification of the sandwich rubbers. The methodology proposed may be used for various purposes: (1) the Technical Committee of the ITTF may use it for the approval of new sandwich rubber products, (2) manufacturers may apply it for product development, quality assurance, technical support and marketing and (3) table tennis players and trainers may apply it for the selection of the optimum rubber for individual player profiles and for estimating the life-time of rubbers with optimum performance to enhance the effectiveness of the training work while simultaneously reducing costs. Nevertheless, more detailed investigations are needed to characterize the surface properties (wear, reduction of adhesion), the fatigue behavior and the influence of temperature and other environmental conditions on all of the parameters mentioned above. What is also particularly needed, is a thorough comparison between polymerscience based properties and property functions and subjective performance evaluations by top players. In establishing correlations between subjective (player based) and objective (polymer science based) material rankings, a powerful tool may be made available to support future product development efforts.

The effect of a new sports drink on fatigue factors in competitive tennis athletes.

BL Marks, T. Angelopoulos, E. Shields, LM Katz, T. Moore, S. Hylton, R. Larson and J. Wingo.

Dept. of Exercise and Sport Science and Dept. of Emergency Medicine, University of North Carolina at Chapel Hill, NC, 27599-8700 and Dept. of Child, Family and Community Sciences, University of Central Florida, Orlando, FL 32816-1250. USA, marks@email.unc.edu

Competitive tennis can be considered to be an intermittent moderate to high intensity endurance sport where fatigue is compounded by heat and hydration issues. Thus, tennis athletes must maintain an adequate fluid balance throughout their competition. In college matches, it is common for players to compete in both doubles and single matches on the same day, often with only 45 minutes rest between matches. When difficult matches go three sets and thus last at least two hours, it is not unusual to see performance deteriorate rapidly by the 3rd set. Past research has shown that supplementing with a 6-8% carbohydrate (CHO) sports drink with electrolytes substantially reduces fatigue and assists to reduce dehydration. It has been suggested that adding a small amount of protein (PRO) to a sport drink would assist to delay fatigue by boosting insulin levels thereby sparing muscle glycogen stores. Therefore, the purpose of this study was to investigate whether ingestion of a new sport drink containing a small amount of protein at regular intervals would reduce fatigue in college tennis players.

Eighteen male tennis athletes from two college teams (Means: age = 20 ± 1.4 ; weight = 76.5 ± 2.4 kg; height = 183.8 ± 7.1 cm) volunteered to participate in a double-blind, randomized, counterbalanced study comparing the effect of a new sport drink (26 g CHO, 6.5 g PRO, 190 mg Na, 64 mg K per 354 ml) to a placebo drink similar in taste, texture and electrolytes but void of PRO and CHO during two 2-hour practice sessions spaced 1 week apart. Food intake was controlled prior to practice. Rest breaks were given every 15 minutes resulting in 8 fluid dosings of 230 ml at each break. Environmental conditions were similar between college sites (31° C, 44% RH). Practice consisted of a warm-up, drills and match play. All practices were considered "hard" (RPE=15) and were immediately followed by 10 trials of a repeated efforts agility test (spider test) with 25 seconds rest between trials.

Nine athletes completed both conditions. Fluid intake (sport drink = 1641 ± 200 ml; placebo = 1831 ± 187 ml), pre-practice weight (76.5 ± 2.4 kg), and pre/post blood glucose (90 ± 1 mg/dL) were not significantly different between test days. Weight increased pre to post for the placebo condition ($+0.3$ kg) but decreased (-0.4 kg) for the sport drink condition (Paired t tests, $p \leq .02$). For both drinks, urine specific gravity increased pre to post (1.013 to 1.024, $p \leq .003$). Time to complete each spider test trial (TIME), heart rate (HR), and rating of perceived exertion (RPE) were taken immediately after each trial. Analyses used a 2 x 10 totally within subjects ANOVA with post hoc pairwise comparisons with Bonferroni adjustments ($p \leq .05$). HR (155-187 bpm) and RPE (13-18) increased linearly across trials. TIME varied from 22.43-23.75 s/trial. No significant differences were found by Group (S vs. P) for any variable, but the main effect of Trial was significant ($p < 0.0005$) where Trial 2 was always greater than Trial 1. There were no significant Group x Trial interactions.

It was concluded that the new sport drink did not delay fatigue in these tennis athletes. The high rate of non-completion was attributed to dislike for the taste and texture of the sport drink as well as gastric intolerance. Future studies with this sport drink utilizing tennis athletes should consider diluting the product mixture and/or decreasing the volume load.

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Does the brain model the laws of physics ? On catching and intercepting flying objects.

J. McIntyre

LPPA / CNRS - Collège de France, 11 place Marcelin Berthelot, 75005 Paris, France,
joe.mcintyre@college-de-france.fr

How does one predict the trajectory of a flying ball so as to synchronize motor responses to the ball's arrival? Studies carried out by David Lee (1981) raised the hypothesis that the estimation of time-to-contact (TTC) is based on the variable τ , a visual parameter that specifies directly TTC, assuming that the object will continue along its path at a constant speed. On the other hand, Lacquaniti et al. (1989) showed that when catching a free-falling ball the nervous system activates arm muscles at a fixed time prior to contact between the hand and the ball, irrespective of the height from which the ball is dropped. In addition, they observed a monotonic relationship between the momentum of the ball at impact and the amplitude of anticipatory electromyographic activity in muscles of the arm. These two observations suggest that the human subject can take into account the acceleration of the ball so as to predict the temporal and energetic parameters of the ball at impact. Nevertheless, it is still not clear whether subjects, when producing this particular response, are able to estimate the acceleration of the ball in real time, based on visual information, or whether the subject resorts to an *a priori* assumption about the effects of terrestrial gravity on flying objects. In a range of experiments conducted on Earth and in orbit we have studied the sources of on-line information and the « internal models » used by the nervous system when catching a fly ball.

The women attitudes toward table tennis in Iran

P. Nourbakhsh

*College of Physical Education and Sport Sciences, Shahid Chamran University, Ahwaz, Iran
sepasi_s@yahoo.com*

The game of table tennis has a relatively long history in Iran. It started when modest sports like gymnastic, skiing, water polo, volleyball, basketball, etc. were brought to Iran by western visitors. It did not take too much time and efforts that these games attracted the attention of Iranian youngsters to choose their favorite sports to play during their leisure time. It was not only boys that found playing table tennis very much interesting, but the girls spent much of their time to learn the skills that were necessary to play table tennis. The purpose of this paper is, first, to review the developmental processes by which the women were attracted to play table tennis in Iran. In order to achieve this goal, then the role that public schools played introducing table tennis through physical education courses, to their youngsters was discussed. It was not only the elementary school that provided facilities and equipment for children to play table tennis during school times, it also received very much attention by intermediate, high school and colleges all of which provided excellent opportunities for their students to learn and play table tennis skillfully. Another word, the role of formal educational institutions in the processes of developing table tennis in Iran was worth to mention. The sport clubs did not appear to play a major role in introducing and developing table tennis at the professional levels for women in Iran. Due to some social restrictions, girls are not allowed to go to sport clubs to learn and advance their skills and to take part as members of a professional team to participate in national or international tournaments. Finally, these restriction was discussed in more details.

Match analysis in racket sports

P. O'Donoghue

School of Applied Medical Sciences and Sports Studies, University of Ulster, Jordanstown, County Antrim, BT37 0QB, UK. PG.Odonoghue@ulster.ac.uk

Match analysis is an area of performance analysis covering both tactical and technical aspects of competition. With respect to racket sports, match analysis investigates performance indicators such as serve performance, shot selection and execution, rally length, winners and errors (Hughes and Bartlett, 2002). Match analysis activities can be classified into two broad types of project; theoretical research studies and practical application for player and coach support. Theoretical research studies apply match analysis techniques in order to study the tendencies of elite players (Drianovski and Otcheva, 2002), providing valuable knowledge and understanding for aspiring players and their coaches. Match analysis allows the complexity of racket sport competition to be reduced to more manageable models identifying the critical factors that contribute to successful performance. Other theoretical research studies have produced performance models that allow the impact of different court surfaces as well as scoring systems to be compared. This information is useful to players, coaches, tournament organisers as well as betting agencies. The practical application of match analysis for player and coach support provides objective information to be used within feedback to players. The quantitative information provided helps avoid coach misperceptions that arise from the use of inaccurate and incomplete recall of critical match incidents. It is essential that performance indicators are interpreted correctly. This involves normalisation to address match length, relating performance indicators to those of the opponent as well as comparison to the performance of peers (Hughes and Bartlett, 2002). Match analysis also assists in the identification of relevant visual feedback that can be efficiently accessed and delivered through the multimedia match analysis systems that are commercially available today. Future research is needed to demonstrate the effectiveness of match analysis in enhancing player performance in racket sports. Knowledge of the effectiveness of different types of feedback and the timing of their provision will encourage more players and coaches to use match analysis within the coaching process. The wealth of match data that has been gathered by researchers will support the development of predictive models that identify the key aspects of performance associated with successful performance. Such models need to recognise that there are many different styles of play that can be successful. Each playing style will place different levels of importance on performance indicators to other styles of play. This knowledge will support talent identification as well as player development. As regulations change, equipment improves and different styles of play emerge, it is essential that match analysis investigations continue.

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P. O'Donoghue

School of Applied Medical Sciences and Sports Studies, University of Ulster, Jordanstown, County Antrim, BT37 0QB. PG.Odonoghue@ulster.ac.uk

To win a Grand Slam tournament, a player must win seven matches within 2 weeks. Because tennis is a score-dependent rather than time-dependent sport, some matches may be longer than others resulting in fatigue and performance decrements. The purpose of the current investigation was to compare the performance of the higher and lower ranked player within Grand Slam singles matches where they had played different numbers of sets in the previous 2 rounds of the tournament. The result in sets of each of the 243 completed ladies' and men's singles match played in the 4 Grand Slam tournaments in 2002 from the 3rd round to the final were accessed from the tournaments' web sites. For each match, the difference in the number of sets the higher and lower ranked players played in the previous 2 rounds was also recorded. Tables 1 and 2 show (for ladies' and men's singles respectively) the outcome of matches for a range of situations arising from the previous 2 rounds of the tournament. For ladies' singles, a Kruskal Wallis H test revealed a significant effect on the higher ranked player's performance of playing more sets than the opponent over the previous two rounds ($\chi^2_4 = 12.5, P < 0.05$). Indeed, the mean rank for the higher ranked player's performance decreased as the difference between the player and her opponent for the number of sets played in the previous 2 rounds increased. For men's singles, a Kruskal Wallis H test did not reveal any significant effect on the higher ranked player's performance of playing more sets than the opponent over the previous two rounds ($\chi^2_6 = 3.6, P > 0.05$). The current study provides evidence that requiring 3 sets to defeat an opponent in ladies' singles can increase the risk of losing subsequent matches. Future work is recommended to further explore relationships between performances in matches and preceding matches within tournaments using process indicators as well as outcome indicators.

Table 1. Summary of analysis of ladies' matches with respect to higher ranked player.

Result in sets	How many more sets played in previous 2 matches than opponent							
	-3 or less	-2	-1	0	+1	+2	+3 or more	Total
Lost 0-2	N/A	0	3	5	6	1	N/A	15
Lost 1-2	N/A	1	2	7	7	1	N/A	18
Won 2-1	N/A	1	5	10	3	0	N/A	19
Won 2-0	N/A	6	21	35	8	1	N/A	71
Total	N/A	8	31	57	24	3	N/A	123
Mean Rank	N/A	74.4	68.9	65.3	43.9	40.2	N/A	

Table 2. Summary of analysis of men's matches with respect to higher ranked player.

Result in sets	How many more sets played in previous 2 matches than opponent							
	-3 or less	-2	-1	0	+1	+2	+3 or more	Total
Lost 0-3	1	3	2	5	2	4	2	19
Lost 1-3	2	2	2	3	2	1	1	13
Lost 2-3	1	0	2	2	2	0	3	10
Won 3-2	2	1	6	2	2	4	3	19
Won 3-1	2	2	7	9	4	4	2	30
Won 3-0	4	4	5	9	4	1	2	29
Total	11	13	19	34	16	14	13	120
Mean Rank	66.2	58.7	66.6	63.5	61.3	49.0	52.3	

P. O'Donoghue and A. Ballantyne²

¹School of Applied Medical Sciences and Sports Studies, University of Ulster, Jordanstown, County Antrim, BT37 0QB, UK. and ²The School of Tourism, Leisure, and Sport, Fermanagh College, Enniskillen, Co. Fermanagh, BT74 6AE, UK. PG.Odonoghue@ulster.ac.uk

A mathematical model (Gale, 1971) has shown that the probability of the serving player winning a point in tennis, P , is given by $P = p_1 q_1 + (1 - p_1) p_2 q_2$ where p_1 and p_2 are the probabilities of the first and second serves being in respectively and q_1 and q_2 are the conditional probabilities of the point being won given that the first and second serve are in respectively. Since Gale produced his model, it has been possible to measure the speed of the player's average first serve, V_1 , and average second serve, V_2 , during matches. The purpose of the current investigation was to analyse the relationship between service speed and Gale's model. Match statistics for each match played in the four Grand Slam tournaments in 2002 were accessed from the tournaments' web sites. Those 569 singles matches which were completed without player retirement and for which service speed data (km.hour⁻¹) was provided were analysed. Table 1 shows the 1138 serving performances within the 569 matches. The difference between the world rankings of the server and receiver were used to represent the gap in ability between the two players within a match.

Table 1. Summary of analysis (mean±SD).

	Ladies' Singles			Men's Singles		
	Australian (n = 83)	French (n = 66)	US Open (n = 65)	Australian (n = 82)	French (n = 63)	US Open (n = 73)
V1	140.44±11.9	142.24±10.5	151.34±10.0	147.7±11.3	163.3±12.5	176.0±9.7
V2	120.1±9.9	121.1±8.4	129.2±9.3	123.5±9.6	132.6±7.9	148.2±12.4
P	0.55±0.10	0.54±0.10	0.57±0.11	0.62±0.08	0.61±0.07	0.64±0.08
q1	0.65±0.09	0.62±0.08	0.61±0.07	0.60±0.09	0.57±0.07	0.58±0.07
q2	0.62±0.11	0.60±0.13	0.66±0.13	0.71±0.09	0.68±0.08	0.74±0.09
g1	0.86±0.09	0.83±0.09	0.86±0.07	0.85±0.10	0.90±0.05	0.91±0.06
g2	0.52±0.15	0.51±0.13	0.54±0.12	0.53±0.13	0.56±0.10	0.56±0.11

A series of two-way ANCOVAs including tournament and gender as between match effects and the gap between the players' world rankings as a covariate revealed that gender had a significant influence on each of the dependent variables ($F(1,1129) > 32.9, P < 0.001$). Tournament had no significant influence on p_2 or q_2 ($F(3,1129) < 2.3, P > 0.05$) but did have a significant influence on all other dependent variables ($F(3,1129) > 6.6, P < 0.001$). Partial correlations were used to relate service speeds to P, p_1, q_1, p_2 and q_2 controlling for the gap between the players. There were negative correlations between service speed and the probability of the serve being in on both first serve ($r = -0.384, P < 0.001$) and second serve ($r = -0.058, P > 0.05$). There was a positive correlation between service speed and the conditional probability of winning the point given that the serve was in on both first serve ($r = 0.552, P < 0.001$) and second serve ($r = 0.237, P < 0.001$). Overall the probability of winning a point on serve, P , was positively associated with V_1 ($r = 0.472, P < 0.001$) and V_2 ($r = 0.395, P < 0.001$). There are implications from the study as players with faster serves have been shown to have an advantage over their opponents.

Reference: Gale, D., "Optimal strategy for serving in tennis", Mathematics Magazine, 5, 1971, pp 197-199

Usefulness of exercise therapy using racket sports in patients with heart disease

K. Ogino¹, S. Makita², J. Satomi³, and T. Yoshida⁴

¹Tottori University, k-ogino@umin.ac.jp, ²Saitama Medical School, ³Ritsumeikan University, ⁴Osaka University, Japan

It is well known that exercise therapy and rehabilitation are useful for patients with heart disease or coronary risk factors. However, it is often difficult for the patients to continue these exercise therapy and rehabilitation because these trainings are generally monotonous and boring. To prevent it, we started exercise therapy using racket sports for patients with heart disease. The purpose of this study was to assess the usefulness of racket sports rehabilitation for patients with ischemic heart diseases or coronary risk factors.

Twenty-one patients with ischemic heart diseases (n=10) or coronary risk factors (7 hypertension and 4 diabetes mellitus) attended the sport training program for one year. They performed racket sports (table tennis and badminton) for 90 minutes twice a week. Symptom-limited cardiopulmonary exercise testings were performed before exercise training and 3 months, 6 months, 12 months after the exercise training. Blood lactate and ammonia were also measured during exercise testings.

None of them dropped out from this training program. The peak oxygen uptake significantly increased by 17.2% after 12-month training (p<0.05). The exercise time and peak work rate also significantly increased after 12-month training (22.7 and 28.4 %, respectively). Blood lactate concentration at 40 and 60 watts during exercise significantly decreased after 6-month training (p<0.05), however, peak lactate concentration did not decrease after training. Blood ammonia concentration significantly decreased at 40 and 60 watts during exercise after 3-, 6-, 12-month training (p<0.05), while peak ammonia concentration did not change after training.

Blood ammonia concentration during exercise reflect energy metabolism of exercising muscle and correlates with blood lactate concentration and exercise capacity (Ogino, et al., 1996, Heart 75, 343-348). Thus, exercise training using sports (table tennis and badminton) improved energy metabolism of skeletal muscle and exercise capacity in patients with ischemic heart disease or coronary risk factors. In conclusion, exercise therapy using racket sports is useful for patients with ischemic heart disease or coronary risk factors.

Pathologies of the locomotor apparatus in table tennis

C. Palieme

National Institute of Sports and Physical Education (INSEP), Medical Department, 11 avenue de Tremblay, 75012, Paris, France, christian.palieme@insep.fr

Is table tennis a sport at risks for the locomotor apparatus ? It is true that to strike a ball of 2.7 g is not a dangerous exercise. On the other hand, the twice-daily two hours practice five days a week, the intensity of the competition can cause a certain number of constraints on joints and muscles. Indeed an epidemiological study conducted at the National Institute of Sports and Physical Education over seven years, on the table tennis players attending the National Training Center shows that among all the consultations carried out, 45.5 % relate to traumatology.

Table tennis being a sport of movement – placement with regard to the ball, it is not surprising to find within the framework of traumatology 49 % of attack on the level of lower limbs. The spine (27 %) and the upper limbs (21 %) are distributing the remainder of the traumatisms with those which have occurred during the practice of collective sports (3 %).

Rare are the acute articular traumatisms (distorsion) contrary to the muscular accidents (elongation, tear) frequent in competition. Overuse pathologies come from heavy loads of training necessary to reach the high level, and reach the tendons (tendinitises) as well as bone structures (periostites). Apart from these inherent and usual traumatisms with the intensive practice of the sport, it is necessary to be wary of the particular clinical pictures which will reveal rare and exceptional attacks : humerus fractures of tiredness, isthmian lysis, or capien osseous conflict.

Finally, the absence of contact with a direct adversary (sport of combat, of team) protects the table tennis players from important traumatisms; but the drive towards excellence does not exempt it wounds which are true diseases of adaptation to the drive what represents micro traumatic pathologies of hyper-use.

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Classical analytic and probabilistic methods used to predict the players' behavior in racket sports proved to yield but a contrasted and mitigated outcome. Recently, some authors proposed another approach in terms of dynamical self-organizing systems (McGarry *et al.*, 2002, *Journal of Sport Science*, 20, 771-781). In this view, the game is no longer a mere addition of each player's individual behavior, but rather a complex system issued from the interaction between the two players and the environment. Accordingly, the study of such a system requires the definition of a relevant collective variable capturing invariance and change in the coupled activity between the two players involved in the game (Haken, 1983, *Synergetics*, Berlin: Springer). In racket sports, the position of the two players relative to each other is of critical importance. As a first approximation, each player basically exhibits to-and-fro motion about a reference position located in the middle of the base line. Thus, we posit that *relative phase* (or *phase lag*) between the two players' displacement is a pertinent variable to characterize the various modes of collective behavior exhibited in a racket sports such as tennis.

Four tennis men ranking at a national level were videotaped while they were instructed to realize long games. Forty trials lasting more than seven rallies were thus collected. After digitization, 2D displacements were decomposed according to their Cartesian coordinates. As *x*-motion (*viz.* back and forth, from the base line) was very seldom and/or of very small amplitude, only *y*-motion (*viz.* laterally, along the base line) was analyzed. A cross-correlation within a moving 5 s window was carried out between the *y*-motion of both players. The lag value close to a lag 0 with the most significant correlation divided the window length yielded an index of the relative phase between the two time series.

Results showed that among all relative phase modes exhibited across all trials, 0° and 180° are most frequent and stable. For the first two time windows, however, relative motion hovered about 180°. Then, two evolutions of relative phase were observed. For 40% of the trials, relative phase did not change from 180° (see Fig. 1). An ANOVA with repeated measures failed to reveal any significant effect on relative phase across time windows ($p > .05$). For 40 other percents of the trials, relative phase exhibited a marked shift (see Fig. 2). An ANOVA with repeated measures detected a significant effect across time windows ($F(3, 5) = 20.03, p < 0.01$). In the last 20% of the trials, no significant trend could be detected, as relative phase never stabilized.

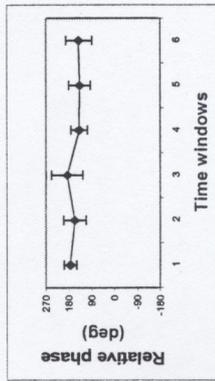


Figure 1

The present study corroborates that relative phase is a valid and fruitful collective variable to characterize the relationship between the displacements of tennis players, revealing various types of evolution as the game proceeds. Extension of such an approach to other racket games and further investigation of the perceptual, energetic, and tactical underpinnings of such modes of relative motion are awaiting.

Australian Neuromuscular Research Institute, Western Australia, ap Pearce@tennisaustralia.com.au

Like all racket sport athletes, badminton players must acquire high levels of skill to be effective in international competition. To achieve these skills, athletes must constantly practice repeatedly over extended periods of time both in closed environments as well as under more open match condition environments. Although the high level of skill is discernable to the eye, from a physiological perspective, we have not been able to measure the effect of repeated practice on the human neuromuscular system.

Transcranial magnetic stimulation (TMS) is a well-established, non-invasive technique that can measure the excitability of the human neuromuscular system as well as map the topography of individual muscles (see review Hallett, 2000, *Nature*, 401, 147-150). A number of experimental TMS studies have shown rapid changes in the human neuromuscular system associated with short-term, simple motor learning tasks (see review Rösler, 2001, *News In Physiological Sciences*, 16, 297-302). However, long-term changes associated from repetitive skilled movements tasks has not been fully studied. Moreover, as TMS is primarily a tool used in the clinical area, the purpose of this study was to investigate the neuromuscular effects and motor cortex topography following systematic long-term skill practice in a non-clinical population.

The study investigated neuromuscular representation of the first dorsal interosseus (FDI) muscle in 3 groups. Group 1 consisted of elite athletes ($n=5$), including a Commonwealth Games gold medalist and an ex-world champion. Group 2 consisted of social competition (pennant) players ($n=5$) who played regularly (at least 3 times per week) but do not deliberately practice their skills. Group 3 was a control group ($n=10$) who do not play any racket sport.

Subjects were tested non-invasively and individually. TMS was delivered using a magnetic stimulator (Magstim, Dyfed, UK). Neuromuscular excitability, measured as motor evoked potentials (MEPs), was recorded using surface electrodes (4mm, Grass). During testing, subjects received a number of stimuli at multiple sites over one half of the scalp (hemisphere), approximately in the area of the motor cortex controlling the FDI. After a short rest interval, the other hemisphere was tested. For both hemispheres, excitability of the muscle was recorded and these measurements were then arranged in a grid system allowing calculation and comparison of the topographic maps of both hands to be completed.

In the control and pennant groups, neuromuscular excitability was similar in both hands (α amplitude $< 0.5mV$ between dominant and non-dominant hands) and topographical maps were found to be symmetrical ($< 3mm$ difference medio-laterally between maps). Conversely in the elite group stimulation evoked higher MEPs in the playing side in all athletes (α amplitude 10.5mV vs. 5.7mV, playing vs. non-playing respectively). Further, all athletes demonstrated asymmetry in the topographical representation of the FDI muscle (6mm to 16mm medio-laterally). Although all the elite athletes demonstrated increased excitability and asymmetry between the two sides, no correlation could be observed between the success of the player and the differences seen. The results demonstrate neuromuscular reorganisation as a result of long-term deliberate skilled practice, however the differences that separate world champions from international athletes from a neuromuscular perspective are subtler and requires further study.

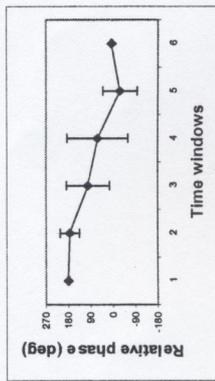


Figure 2

In the 20th century, there were 43 major technique innovations that influenced the development of table tennis significantly. Among these 43 major technique innovations, 35 were achieved by the practical exploration of coaches and players. Among these 35 innovations, 3 were achieved by combination method, 7 were achieved by transplantation method, 6 were achieved by reverse method, 9 were achieved by chance and 10 were pure practical exploration. Among these 10 pure practical explorations, 7 were the further development of traditional play styles. The other 3 were practical exploration in order to adapt new play styles.

The number of technique innovations achieved by China is much more than that achieved by other countries. China achieved 23 technique innovations while the number of technique innovations achieved by all other countries is 20. The number of Chinese technique innovations participated by scientific research personnel is 4. The number of foreign technique innovations participated by scientific research personnel is 4 too. 3 technique and style innovations of China were completely accomplished by the project teams consisted of scientific personnel, coaches and players. This is a prominent achievement. For example, the innovation of pen-hold grip inward pimples bat fast attack style made 3 players using this style win the world doubles championship 5 times. Cooperating with other players, 4 players using this style won the world doubles championship 4 times. The successful innovation of back-face attack of pen-hold grip brought Chinese traditional fast attack style to a new splendence. The representative player of this technique, Guoliang-Liu, is the only one player who has won the championships of every kind of world table tennis matches by now.

As for the number of technique innovations in different decades, China and the whole world had same trend. Table tennis is highly developed now and spontaneous innovation will become more and more difficult. So, we must teach table tennis coaches, players and scientific researchers the theory of innovation systematically and enhance the organization and management of technique innovation work.

Introduction

The aim of this study was to describe two strokes: the top spin rotation and the striking top spin. The study includes an analysis of the movement, and the study of relative and temporal structures such as those developed in the centro-peripheral theory (Schmidt R.A., 1975, Psychological Review, 82(4), 225-260). The goals were to create patterns of profiles, to create a 2D representation of the two strokes, and to study the motor control. The hypothesis being that it was in reality a gesture with variations which means that these two gestures belong from the same generalized motor program (PMG).

Methods

Eight players participated to the study, all of them were members of the Senior French team: 3 were classified among the best 100 table-tennis players, five were classified between the 100th and the 300th. During a ball distribution while training, they realized a pseudo-random series composed of 20 tops spin rotations and 20 striking ones. We collected the data (on arm and racket) on video. Only the tests included in the confidence interval at 95% of the normal law which represents the distribution (Shapiro and Wilk's test: $P < .05$) on two variables of the trajectory (distance bounce/net, bounce height) were being considered. The video data have then been digitized (25Hz) and studied frame after frame. The articulations (elbow and shoulder) and the tip of the racket have been indicated on each frame and have been transformed into figures which have been used to the 2D reconstruction and to the study of stages, thanks to a software programme (3Clic 2.0.0©).

Results and Discussion

The major results are that the relative temporal structure is identical, so it seems that these two strokes come from the same PMG. The vertical stretch (Bottom/Top) is a surface characteristic which distinguishes these two strokes whereas the anteroposterior stretch is identical. The individual observation of the representations shows a tendency to go further forward and less upwards for the striking top-spin, which is in harmony with the ground discourse. The two forms of movement, according to the strokes, differ one from the other much later. The form doesn't seem to be at the source of the differentiation of the two strokes, neither does it produce more efficiency. The change in the form between the two is often minimal and takes place between the impact and the end of the movement. A dominant pattern profile appears but counter examples also appear, so the results must be relative. As a matter of fact, the dominant profile consists in the minimal modification of the gesture and as a result there is a decreasing quantity of information given by the opponent but maybe to the prejudice of efficiency. It is worth observing that the most untypical concerning the organization are the best classified. These players belonging to the world-wide 100 top keep the same temporal structure which is relative when slightly modifying the striking top spin form and the rotation top spin in order to preserve the highest efficiency (with the possibility for the opponent of limited information), on the other hand, our results show the left-handed players mask their strokes in a more performing way and differentiate their strokes later on. If we consider the practical side, this study shows the importance a) of the combined approach of the two tops spin as soon as possible while learning (as soon as the control has reached the motor level), and b) to focalize the player's attention on the ball's action and on where the ball has its impact that are the tops spin's main elements.

Introduction

The studies on emotion in sport show its impact on performance but have rarely been interested in its evolution even during competitions (Hanin & Syjää, 1995, The sport Psychologist, 9, 169-187; Robazza, Bortoli & Nougier, 2000, Journal of Sport Behaviour, 23, 144-163). Lazarus (2000, The sport Psychologist, 14, 229-252) insists on the need to make studies in real situations to get a better characterization of emotions in sport and to understand its relationships to performance. We have realized a study on table-tennis players' emotion during matches referring to the context of a semiological analysis proposed by Ria & Durand (2001, Les Dossiers des Sciences de l'Education, 5, 111-123). On the basis on Peirce's semiotic (1931-1935), they have proposed to study emotions making a difference between affective states and feelings. The affective states are a matter of primacy of the experience, that is to say a synthetic sensation felt by the player. It is diffused sensation of being at ease or ill-at-ease, of comfort or discomfort, pleasantness or annoyance. These affective states are deep-rooted in the body and can practically be verbalized by the player. Our study aim to characterize the emotional dynamics of table-tennis players' activity during a match and to identify the factors influencing these dynamics.

Methods

Five volunteers took part in 20 matches Male National 1 Level. Three types of data have been collected : a) match video recordings, b) self-assessment by the tennis-table players of their emotional states during a match on a seven point scale from viewing the video recording (the person taking part was invited if he wished to express what seemed important to him concerning his assessment). The affective states (AS) have been documented from an assessment scale of the affective states (or EEA scale) which had previously been ratified (Ria, 2001, Thesis, University of Montpellier I). This scale enables the player to assess and to express synthetically the positive or the negative aspects of his experience. The EEA scale is composed of seven points : +3 (very pleasant or very comfortable) to -3 (very unpleasant or very uncomfortable). The verbalizations have totally been recorded thanks to a digital tape-recorder and have also been retranscribed. The data has been treated in three different stages : a) graphs showing the EEA evolution following the difference in score, b) a statistical analysis of the co-variation between the AS and the difference in score, as well as an analysis of the variance between different periods of the match, and finally, c) an analysis of the verbalizations.

Results and Discussion

We have observed a co-variance between the AS and the difference in score, and the causality has been confirmed by the verbalizations. Some characteristics (player, the fact of knowing the opponent, particularities of the previous matches against this opponent, the match being a stake) had an influence on this co-variation. Moreover, the analysis of the variability of the AS was depending on when the match was taking place. Depending on the situation, the players' AS were evolving in a synchronous manner with score, in altered manner or in an independent manner. This study has allowed to question the existence of emotional patterns : a change in the emotional dynamics can intervene according to the situation, the player can go from a steady speed (with a phenomenon of adhesion, or hysteresis) to an unsteady speed (with an important variation of AS). The dynamics of the AS has shown important variations with precise facts, which led to a notion of feeling. We have planned to have extra studies in order to characterize how the emotional dynamics has an influence on the decision taken and how well these actions have been realized.

In the contemporary Olympic movement, the whole system of sport activity is focused upon the training and participation of sportsmen in the Olympic games, world and European championships. The main criteria of effective training systems of table tennis players is the presence of gold medals and prizes won by the latter during the Olympic games.

In the present conditions, high sport results can be achieved only if the long term physical training is regarded as a unique integral system with many interconnected and inter-conditioning components.

In order to understand the system of the long term training of highly qualified table tennis players, we will refer to illustrative symbols. The model of a stage by stage training is the following : A results in B, B results in C, C results in D, D results in E, and E results in F which is an Olympic champion. We can't get F directly from A as the stage by stage physical training appears to be the process of detecting in A the properties of the general training of children at the pre-initial stage of training. These properties enable us to reveal the successive developments of talents and to predict the situation F. Let us compare the determined structure (described above) to the intuitive structure : B results in C, C results in D, D results in E, and E results in F (Olympic champion)

We can see the difference. Depending on the number of undetermined units in the system of training of table tennis players, this structure is mainly built upon presumptions. The reason of it is that the training technique starts from various initial levels (in our case, from B).

In sport practice, especially among young coaches, we may come across the third form of a long term training, that is : the sum $A + B + C + D + E$ results in F (Olympic champion). This is an erroneous understanding of a long term training process as the latter is not just the total of the summed variables, but a dynamic creative process based upon the law of transition from quantity to quality.

So, scientific research in this direction contributes, to some extent, to disclosing the essence of the main moment of understanding "the way of victory".

Qin Zhifeng¹ and Xie Wei²

¹Singapore Table Tennis Association, 297c Lorong 6, Toa Payoh, Singapore 319389, stlanet@singnet.com.sg, ²Singapore Sports Council

The Women's World Cup Table Tennis Competitions 2002 was held in Singapore from 30 August to 1 September. We used computerized table tennis game analysis system to do statistics for all the matches of top 8 players. We divided one match into three parts according to its own features: service and attack (SA part), returning service and attack (RSA parts), rallies (R parts). We found the following results for elite female players.

The players laid more stress on the effect of SA part and RSA part as they tried to gain the initiative by striking first. Therefore these two parts accounted for about 60% of the match. The average winning points rates for match winners were 64.6% and 58.5% in these two parts, while the losers were only 55.9% and 47.3%. The R part showed the players' technical strength and it accounted for about 40% of the matches. The average winning points rate for the winners was 49.2%, and the losers were 39%. The sports experts in China established the standard of 3 parts' technical evaluation 20 years ago and revised it 2 years ago. Our research shows it is still much useful for match analysis.

The players increased their results in RSA parts comparing with the former technical data. The winners reached super excellent level, and the losers also got good level according to the standard of 3 parts' technical evaluation. It may be because the receiving service becomes easier after the reform of ball size and service rule.

The players did their best to use offensive techniques more in the matches. Our research showed that 54.4% of the last strokes were topspin, attack and forward driving loop, and 13.1% were smash, push and flick. So about 2/3 of the matches were finished by attack. The more accurate the players hit, the more chance they will win the games.

More than 80% of the matches were finished within 3 rallies (each player hit ball no more than 3 times). It is no much difference with the situation before the change in size of the ball, in point system and in service rule. How to increase the match rallies and to make the competitions more interesting to watch is still the problem.

G. Ruiz Llamas and D. Cabrera Suarez

Departamento de Educación Física, Universidad de Las Palmas de Gran Canaria, Spain
gruiz@def.ulpgc.es / mcabrera@def.ulpgc.es

We try here to make a comparison of the results obtained by several groups of players, at different levels, in the performance of first service, using several kinds of rackets. The aim was the observation of power first, and later on, accuracy, when carrying out first service. Our intention is to determine the influence of materials, i.e. rackets, in this particular activity. We also tried to observe efficiency in nowadays players when using the old type of rackets, since many consider they are the cause of limitation in speed when performing first service.

Objectives: analysing, for every player, the power in first service depending on the type of racket used.

- Analysing, for every player, the power and accuracy in first service, depending on their category or level.
- Comparing several groups of players according to their level and the type of racket used.
- Observing the efficiency of every type of racket according to the results analysed.
- Analysing the efficiency in first service, and the speed obtained with the old metal and wood rackets by nowadays players.

Sample: the observation was carried out through 4 groups of players, classified according to their level. The classification was made after the usual ranking (international, national, provincial, local or club level) except for beginners, whose level was obvious.

Methodology: each group had to perform a series of first services, to determine both power and accuracy. They had to get at least five good ones, which were measured by radar. The first services were repeated with every type of rackets. For measuring accuracy, the player had to perform his first service pointing at one of the three parts of the grounds which had been previously determined.

Results: they can be seen in the table below, for every group in using the different types of rackets. We specify maximum and average speed, and the average of attempts necessary to succeed in the five types of service that had been previously determined.

	GROUP 1	GROUP 2	GROUP 3	GROUP 4
WOOD	V. MAXIMA 178 km/h	159 km/h	110 km/h	78 km/h
	V. MEDIA 166 km/h	135 km/h	91 km/h	68 km/h
METAL	INTENTOS 12	15	19	24
	V. MAXIMA 182 km/h	170 km/h	116 km/h	85 km/h
FIBRE	V. MEDIA 170 km/h	140 km/h	101 km/h	72 km/h
	INTENTOS 10	13	17	20
SUPER	V. MAXIMA 189 km/h	176 km/h	136 km/h	113 km/h
	V. MEDIA 174 km/h	158 km/h	128 km/h	85 km/h
SUPER	INTENTOS 8	9	14	14
	V. MAXIMA 184 km/h	173 km/h	148 km/h	120 km/h
SUPER	V. MEDIA 178 km/h	160 km/h	130 km/h	101 km/h
	INTENTOS 7	8	9	10

Strength training maintains muscle mass and improves maximal dynamic strength in professional tennis players : a study of two cases.

J. Sanchis Moysi¹, C. Dorado and J.A.L. Calbet

Departamento de Educación Física, Universidad de Las Palmas de Gran Canaria, 'El Cortijo Club de Campo, Gran Canaria, Spain, joatenn@terra.es

Introduction

It has been reported that an important factor for optimal strength generation in tennis strokes is the neuromuscular activation of the muscles mainly involved in each tennis stroke, during the initial phase of arm acceleration (Elliot, Tennis, 2002, 1-29). Neuromuscular activation can be improved with explosive strength training (Häkkinen, Strength training for sport, 2002, 20-36). We hypothesize, on the other hand, that the maximal level of dynamic strength can be enhanced or, at least maintained, during the whole competitive season via a well designed strength training program. Therefore, the main purpose of this study was to analyse the effects of tennis competition on the maximal dynamic strength (MDS) in two female professional tennis players (P1 and P2). We present the improvements of MDS after a weight-lifting strength training program (STP) and the evolution of MDS during the competitive phase of the season in two different tennis players who either performed or not a single session of MDS training per week.

Methods

Two professional females tennis players from the same population, P1 (22 years, 75.6 kg, 165.5 cm, top 50 WTA ranking) and P2 (15 years, 61.6 kg, 171.5 cm, top 100 WTA ranking), followed a 4 and 12 weeks STP to improve the MDS, respectively. P1 had no previous experience in strength training with weight-lifting exercises. During the training session, both players performed 3 series of 8 repetitions each, executed at maximal speed, at 70-80% of 1 MR, with 5 min rest period between series. During the strength training periods, subjects alternated sessions of upper body (UB) or lower body exercises (LB), with a frequency of 4 sessions/week. During the competitive phase of the season, P1 performed 1 session/week of strength training (1 series of 3 MR per exercise), while P2 did not add any weight-lifting exercises to her training routine. The MDS was measured before (T1) and after (T2) the STP, as well as at the end of the tennis season (T_{END}) with a test of maximal repetitions (between 3 and 12 repetitions, with 3 different load levels).

Afterwards, we determined the 1 MR by extrapolation of the semi-logarithmic relationship load / In (number of repetitions). Total and regional body composition was measured after the STP and at the end of the tennis season by dual energy X-ray absorptiometry (DXA)(QDR-1500, Hologic Corp, Waltham, MA) (Sanchis Moysi et al., Science and Racket Sports II, 1998, 34-43).

Results

Both players improved the MDS in UB and LB exercises. This improvement was higher in P2 than in P1 (126% vs 34% and 79% vs 36% for UB and LB exercises, respectively). Compared with T2, MDS at the end of the season was increased in P1 (UB by 16% and LB by 21%), while MDS decreased in P2 (UB by 18% and LB by 22%). Furthermore, between T2 and T_{END}, P1 maintained the muscle mass of the upper and lower limbs (2346.6 vs. 2365.4 g, 2140 vs. 2184.3 g, 9100.3 vs. 9192 g, 8746 vs. 8970.9 g, for the left arm, right arm, left leg and right leg, respectively). In contrast, P2 lost some muscle mass (1942.1 vs. 1877.5 g, 2196.5 vs. 2186.7 g, 7175 vs. 7966.4 g, 7647.9 vs. 7574.5 g, for the left arm, right arm, left leg and right leg, respectively).

Conclusions

In summary, this study shows that in female professional tennis players the gains of maximal dynamic strength obtained during the preparation phase of the season can be maintained, and even slightly increased, if 1 session/week of explosive strength training is performed during the competitive phase of the season. This improvement of strength was likely mediated via neuromuscular mechanisms, inasmuch as the muscle mass remained unchanged during the competitive season. In contrast, the total elimination of strength training was accompanied by some loss of muscle mass and muscular strength, which can negatively affect performance during the rest of the season.

Spin detectable table tennis balls

M.J. Scott

USA Table Tennis, Seattle, Washington, USA, mjxxxx@earthlink.net

Speed and spin are two key elements of modern racket sports. The velocity of the ball is readily visualized and understood by the spectator. However, the ball's rotation or spin is not as detectable or apparent because present racket sports balls are of a solitary, uniform color. In table tennis, they are either all white or all orange. Also in table tennis, the numerous types of approved rubber surfaces such as anti-spin, long pips, etc... add to this confusion in regards to the ball's actual rotation.

Not realizing the tremendous variations in spin during a particular volley, spectators may wonder how anyone could have missed such a "simple" return.

Having table tennis balls with a standard, acceptable, visible, and obvious design on them would help obliterate this confusion. A design on the ball would allow spectators, as well as the players, to readily detect the relative degree of spin and make the game more understandable.

This concept is not new but it should be considered. Multicolored basketballs have been utilized in the American Basketball Association and the Women's Professional Basketball Leagues. Being able to determine the relative spin on the basketball makes the game more interesting to many. Perhaps the same would be true in table tennis and possibly in other racket sports.

Some designer table tennis balls that I have encountered, and a few I designed, are hereby presented.

C. Sève

CETAPS UPRES JE 2318, University of Rouen, France, cseve@compuserve.com

The activity of expert table tennis players during matches under the old scoring system has been studied within the French Table Tennis Federation. The results showed that the players' actions were organized to form sequences dividing each match into phases of exploration and execution (Sève, 2002, Table Tennis Sciences, 4 & 5, 167-176; Sève, Saury, Theureau & Durand, 2002, Cognitive System Research, 3, 501-522). Matches began with an inquiry period during which the players looked for strokes that impinged upon the opponent's play. Regardless of the outcome of the inquiry phase, however, it had to come to an end when the players felt they could no longer afford to sacrifice points for fear of losing the match. On September 1, 2001, the scoring system changed, and the goal of the present study was to evaluate the impact of this new system on elite table tennis players' activity during matches.

Four top-level table tennis players from the French Men's Table Tennis Team volunteered to participate in the study. Matches during the France Championships in 2002 were videotaped and the players' verbalizations as they viewed the tapes were collected *a posteriori*. The data were processed within the methodological framework of *course-of-action* theory (Theureau, 1992, Le cours d'action). The data were analyzed by (a) transcribing the players' actions and verbalizations, (b) decomposing their activity into elementary units of meaning, (c) grouping these elementary units into larger sets called series, and (d) constructing graphs to present the dynamics of the activity during matches.

The analysis revealed nine series of activity: four exploration series (Look for effective serves, Look for effective serve returns, Look for effective first attacks, Look for winning game configurations) and five execution series (Reproduce effective serves, Reproduce effective serve returns, Reproduce effective first attacks, Reproduce winning game configurations, Perturb the opponent). Each series grouped together all elementary units pertaining to the same preoccupation, and they were the same as those revealed in earlier studies of matches under the old scoring system. Conversely, the organization of the series during the matches was different. The exploration series ended much sooner under the new scoring system than under the old system. The most likely explanation is that the shorter sets of the new system no longer allow players to test the effectiveness of different strokes without increasing their risks of losing the set. Analysis also showed (a) modifications in the series of actions oriented toward finding effective serves and serve returns, (b) difficulties recalling some of the match events, and (c) a loss of familiar references during the matches. Under the old scoring system, the players relied on successions of five serves (or five serve returns) to (a) facilitate the identification of effective serves (or serve returns), (b) memorize the succession of serves, and (c) divide the sets into three characteristic phases (start, middle and end of set). Under the new scoring system, which requires that players alternate serves and returns every two points, this organization has become obsolete and the players must now find the most effective means to adapt.

Shawn Sun

Trise Enterprises Group, 2755 East Pender Street, Vancouver, British Columbia, Canada V5K 2B9, sunliu@atcompnp.com

Table tennis game did not experience any major changes for a long time even after it became a full Olympic sport in 1988. To modernize table tennis game the International Table Tennis Federation (ITTF) did a few drastic changes in the last two years:

Adopted 11 Points Scoring System in September 1, 2001

Adopted New Service Law in September 1, 2002.

It seems that the changes have achieved its initial success although the full effects is yet to be felt since players are still learning to adapt to the new system.

The changes made so far by ITTF are heuristic by nature. How to evaluate the success or failure of any change objectively? What is the next step to improve the sport? It is this author's view that a scientific approach is needed to assess any change beforehand and afterwards so that the sport can be improved constantly, systematically, not sporadically.

A rigorous model is built so the recent changes can be evaluated, and further changes can be indicated : the ways table tennis game can be played.

R.A. Sherman, T.J. Creasey and A.M. Batterham

Applied Physiology Research Group, Department of Sport and Exercise Science, University of Bath, Bath, BA2 7JY, UK. E.a.sherman@bath.ac.uk

The ability to monitor and test athletes in their natural sporting environment gives any resultant findings ecological validity. A drawback of field-testing is the loss of control over external variables, compared to laboratory-based testing. As a result, the on-court ghosting protocol was designed to enable field-testing but with a high degree of control. Furthermore, to provide meaningful results, the protocol must have validity when compared to a normal, competitive squash match. Therefore, the aim of this study was to ascertain whether the on-court protocol replicated the physiological demands of a competitive squash match.

Seven highly-trained, male squash players (age 23 ± 5 yr [mean \pm SD], body mass 70.9 ± 4.2 kg, height 181 ± 3 cm, $\dot{V}O_{2\max}$ [$n = 3$] 69.9 ± 0.5 ml $\text{kg}^{-1} \text{min}^{-1}$) were recruited from the University of Bath squash teams. Subjects gave their written informed consent to participate in the study, which had previously been approved by the local NHS research ethics committee. The main experimental trial consisted of a five min self-selected warm-up followed by four match-play (MP) blocks of ghosting. In total, each MP block lasted 11.5 min separated by a 90 s rest period. Subjects received an auditory cue to ensure they maintained the desired ghosting speed of either 3 s or 3.5 s. Heart rate (HR) was recorded every 5 s throughout the trial using short-range telemetry (Polar Electro Oy, Vantage NVTM, Kempele, Finland) to obtain mean and maximum HR (max HR) during MP. Court air temperature and humidity were measured using a combined digital device (Testo Ltd, Testo 625, Alton, Hampshire, UK). Subjective ratings of perceived exertion (Borg, 1973, Medicine and Science in Sports and Exercise, 5, 90-93) were obtained at the end of each MP block.

Mean HR during MP was 170 ± 21 beats min^{-1} with a max HR [$n = 3$] of 182 ± 12 beats min^{-1} . Expressed relative to age-predicted maximum and maximum HR attained during the progressive incline treadmill test (HR @ $\dot{V}O_{2\max}$), mean HR across the four MP blocks was 86 ± 8 % age-predicted max and 90 ± 4 % HR @ $\dot{V}O_{2\max}$ [$n = 3$] during MP. A progressive subjective fatigue was encountered, with RPE rising from 14 ± 3 at the end of Game One to 16 ± 3 at the end of Game Four. As a result of MP, court temperature and humidity rose 0.7 °C and 3.9 % and were 23.1 ± 1.0 °C and 47.3 ± 2.7 %, respectively, at the end of Game Four.

The HR findings from this study show that the physiological demand encountered during the simulated MP was similar to previously reported HR data during a normal, competitive squash match (Brown and Winter, 1996, Journal of Sports Sciences, 1, 68-69). Furthermore, the HR data provides further evidence that squash is a high-intensity sport. In conclusion, the on-court, ghosting protocol used in this study provided a similar physiological challenge to squash players as a competitive match.

O. Skenadjji, F. Borrani, S. Ambrosino, J.P. Micallef and G.P. Millet.

UFR STAPS, 700 Avenue du Pic Saint-Loup, 34090 MONTPELLIER, France, skiky@hotmail.com

Table tennis is in the heart of a profound revolution for some years. On one hand on the material plan, on the other hand at the level rule. These turnovers pull again marks for table tennis players, as much on the technical plan (IMOTO, and al. On 2002), as on the physical plan. This last aspect, still underestimated, was studied concerning five muscles of upper limbs (biceps, triceps, pectoral muscle, deltoid muscle and latissimus dorsi muscle). Fourteen players, of national level ($n=7$) and of regional level ($n=7$), realized each, eight exercises of 30 s [forehand and backhand x 4 velocities of ball]. An electromyographic recording (EMG) (DelSys Corporation ©, the USA) allowed to treat the activity (ARV) of five involved muscles. Besides, ball velocities ($\text{km} \cdot \text{h}^{-1}$) were measured by a radar (Speed Check, Canada) placed over the net. One notices values always superior at the athletes of high-level than at the players of a regional level concerning the ball speeds (for example, at the 3rd velocity), at the same moment in forehand (50.0 ± 2.05 vs. 58.96 ± 1.52 $\text{km} \cdot \text{h}^{-1}$; $p < 0.05$) and in backhand (53.09 ± 2.63 vs. 44.2 ± 1.8 $\text{km} \cdot \text{h}^{-1}$; $p < 0.01$). Besides, the latissimus dorsi muscle is a muscle more used in high speeds of ball by the players elites than regional, while no difference exists for the other muscular groups. It thus seems that the elite players use more the muscles of the trunk while the regional players limit themselves to the muscles of the arm. Finally, we propose for elite players a specific physical preparation through exercise in room of body-building.

In different historical period, the development of the table tennis rule and technique-tactics must result in the specific and effective technique-tactics changes. Every technique-tactics depends on the five crucial factors such as speed, strength, spinning, falling-point and accuracy. The forehand break-through tactics evolves from all kinds of tactics and is adaptable to the modern table tennis development. In 1990s' European players never found the method which defeated the Chinese first three-ball technique and all-round technique. After the forty-fifth World Table Tennis Tournament, some players such as Swedish... etc are bold to use the forehand break-through tactics to defeat our super players many times. At present, every country studies the forehand break-through tactics and training. Although there is not a integrated theoretical system to guide, the fashionable and effective tactics has been formed. This article analyses and studies the forehand break-through tactics through the tournament between Zhang Yi Ning and Niu Jian Feng in order to offer some instructive advices for Chinese table tennis tactics system.

Result and analysis

The concept of the forehand break-through tactics : (1) the receiver first transfers his rival's forehand point with the combination of long drives and drop shots and they do the brehand-attack-counterattack exercises. When a left-hand player and a right-hand player do the exercises, the left-hand player can do the exercises of the forehand-straight attack of a half table after transferring his rival's forehand point and attacks backhand after the first ball ; (2) the main player first attacks upspin and then attacks and counterattacks. After two balls, the main player transfers his rival's forehand point and attacks backhand after his rival's angled backhand counterattack. If the level of players is high. They may irregularly do the exercise. The requirements are to early start to attack and transfer widely and attack straight

The analysis of the forehand break-through tactics application : (1) the statistics of Zhang Yi Ning's service stage : from the data, we find out that the proportion between Zhang Yi Ning's backhand attacks and her middle-forehand attacks is 10: 13. Zhang Yi Ning mainly attacks Niu Jian Feng's forehand. Moreover, Zhang Yi Ning backhand-straight attacks' effect is better, which avoids the bad conditions of restraining backhand attacks each other. (2) The statistics of Zhang Yi Ning's receive stage : the stage is wonderful because Zhang Yi Ning doesn't lose one point. Zhang Yi Ning uses the short-ball-attack technique and forehand-break-through technique reasonably and persists in attacking forehand after two backhand balls or immediately attacks forehand. Zhang Yi Ning restrains Niu Jian Feng's backhand speed with spinning, combined with pivot backhand attacks This tactics is effective. (3) The statistics of Zhang Yi Ning's midst stage : Zhang Yi Ning's forehand break-through tactics gets five points and loses three points; the tactics to restrain Niu Jian Feng's backhand attacks gets three points and loses two points; the tactics to restrain Niu Jian Feng's backhand attacks gets five points and loses one point.

Conclusion : as the technique-tactics level of every country player rises and tournaments are more competitive, the contradiction of offence and defence often changes. So, on the basis of bettering the forehand break-through tactics, it is necessary to improve all-round technique. Although the forehand break-through is a effective tactics, a player can't entirely copy others' technique-tactics. A player should do his best to actively transfer his rival and form the technique-tactics system which is adaptable to himself.

The application of eleven points rule changes the technique-tactics and the technique-tactics psychological mode of twenty-one points rule. Players of all kinds of technique-tactics styles must change in order to break through and take active superiority in the tournament of eleven points rule. The Chinese players must change thought, keep the good experiences of twenty-one points rule, particularly actively go to research the laws of the technique-tactics application of service, return and persistent stages of eleven points rule and the methods adjusting the psychology of trainings and tournaments in order to effectively explore a mode which makes Chinese keep superiority for long time.

Result and analysis

From the data of every points stage, the percentage of getting points of Li Nan's middle service stage, 79% was highest, which made Li Nan take points superiority in order to defeat Boros. The more reasonable technique-tactics application of the return stage and persistent stage of the crucial balls after nine points reflects Li Nan's stable mental capability, which is the crucial factor of winning the tournament.

At present, every country mainly studies the forehand break-through tactics. The chop of return should be combined with powerful drive. The active return technique will be the future development trend. The effect of only using chop technique is not obvious. Players still mainly scramble the first four-ball in the singles tournament. When Boros changed to attack Li Nan's backhand point, the quality of Li Nan's offence and forehand continuous drive was worse.

However, Li Nan's forehand point lost 11 points in the passive persistence. We easily find out that the capability of Li Nan's penholder grip backhand controlling balls' direction change is better.

Boros also tried to break through from Li Nan's forehand point in the persistent stage. In the persistent stage, Boros got 16 points from Li Nan's forehand point, which should attract us.

Conclusion

Li Nan mainly used close-net service combined with Boros' middle quick service. The change of Li Nan's service direction was more dexterous. When Boros' return was bad, Li Nan's block should be more powerful. Li Nan should impart spin to the ball and change fall-point rather than be too much powerful when the first return is the half-outside-table ball. If there are chances, Li Nan should powerfully drive or chop Boros' backhand point. But Li Nan should pay attention to defend the active direction change of loop, swing back quickly, impart power to chop and strengthen the succession of the fourth ball of return.

As long as players actively adapt to the eleven points rule tournament, strengthen the helpful adjustment of psychology, they can better show their own capabilities and win tournaments. If players ignore the adjustment and change of psychology and only study technique-tactics, they can't probably show their capabilities well when they meet with the powerful balls of their rival.

A table tennis tournament is made up of service stage, return stage and persistent stage. How do the getting-point percentage and using percentage of three stages change in the 11 points rule? By the statistics and analysis of 56 tournaments of 11 points rule in the recent year, this article provides some thoughts to be referred to. The time of a 11-point-rule tournament is short, the rate of appearance of its crucial balls is high. Its casual rate is high. Its rhythm is faster. Especially, a table tennis tournament has more changes than other events. These ask the exact study of technique-tactics of every stage of training and tournament to find the 11-point rule law.

Results

1. Service stage : compared with 21-point rule, the getting-point and using percentage of the 11-point-rule service stage has not much change. The 11-point rule uses the circulating service rule of 2 balls per player. Players' service and drive after service in this stage is mainly flexibility and powerful. Drive after service is the important means of getting points. Excellent players' getting-point percentage in this stage is often excellent. Moreover, the data of the statistics table also prove that whether a 21-point-rule tournament or a 11-point-rule tournament, the average getting-point percentage in this stage is 66%, which is excellent.

2. Return stage : Chinese players have more change in this stage. The getting-point percentage in this stage rises from 44.9% to 53%. The using percentage decreases from 32% to 20%. There are two reasons. The first reason is that Chinese players strengthen the quality of high balls and chop balls. The second reason is the inherent law of 11-point rule. (Chinese players don't completely master the 11-point-rule law and sometimes play on the return though of 11-point rule.)

Player should first play powerfully and then play steadily. Players should attach importance to the quality of return. Whether driving or controlling balls, players should be active to create advantageous conditions for persistent stage. In the way of tactics, players should attach importance to increasing the forehand break-through tactics on the basis of present tactics and make efforts to get good chances and superiority. In addition, players' first judging and consciousness of returning balls should be fast. Players should be ready to deal with changes.

3. Persistent stage

The using percentage of persistent stage of 11-point rule is increased by 12%. Chinese players' getting-point percentage in this stage hasn't obvious changes. Compared with 21-point rule, the technique-tactics of persistent stage of 11-point rule has more change. Players' mostly play on the basis of their own technique-tactics' characteristics, playing style and planned tactics. Players should play on the basis of their own rhythm. Players should first play powerfully and actively on the basis of reasonably and effectively using technique-tactics in persistent stage and make efforts to be active, speed and flexibility. Players should be not only power but also accuracy. As long as combining power with accuracy, players can make it. From the statistics, it is found out that few players is good or excellent in persistent stage. There are two main reasons. The first reason is that over-power leads to the increase of turn-over. The second reason is that over-stability leads to the ball quality of balls and being passive.

Conclusion

1. Because of the increase of key and crucial balls in the 11-point rule tournament, players should decrease the turn-over of continuous attacks.
2. Players should strengthen the use of two straight balls when offence becomes defense.
3. Players should persist in playing on the forehand break-through tactics.

The understanding of characteristics behind the table tennis sport helps coaches and players to master the training process and then improve the competition quality. The characteristics of table tennis sport includes : special-purpose features, technical features, technical structures, competition features, special-purpose principles, rules of winning, winning elements, technical style of players, major principle of coaches, technical trends, training theorems, and training schedules (training content, methods, workload, and evaluation).

The optimal training techniques for players at elementary school stage

Techeng Wu and Chinshu Ouyang

*Beijing University of Physical Education, Beijing, 100084 China,
National Lien Ho Institute of Technology, Miaoli, 360 Taiwan, hs3897@nc.hcc.edu.tw*

The initiative training of table tennis players at elementary school stage will heavily effect their potential achievement. The optimal technical training includes two major parts: technical structure and technical training methods. Technical structure focuses on optimal preparation, decision, displacement, hitting, and movement recovery. As for the technical training methods, three problems need to be solved: what to train? how to train? how hard should be trained?

The training experience upon table tennis team in NCTU

Techeng Wu and Koumau Chen

National Chiao Tung University, Xinzhu, 300 Taiwan, hs3897@nc.hcc.edu.tw

The author has been the coach of table tennis team of National Chiao Tung University for six years. His achievements include the winning of Mei-Chu competition in the table tennis item and second place of college cup in Taiwan contrary in 2002. The success experience can be then summarized as follows: follow the world wide technical trends, enforce the training principle, analyze the characteristics of competitor, draft a plain before competition, and strategy enforcement in training and competition.

P. Utiérrezki and A. Wiczorek

University School of Physical Education, Tennis Department, Poznan, Poland, utierrezki@awf.poznan.pl

Competitions in tennis are played on different surfaces, which require various tactical and technical abilities. Therefore usually different players win the most important tournaments played on fast (e.g. grass) and slow (e.g. red clay).

The purpose of this study was to describe game patterns used by worlds' best tennis players during final matches of two most important events played on the slowest (Roland Garros) and the fastest (Wimbledon). This might be important not only for better understanding the game but also should help the players to adopt their styles to various situations.

Two finals of men's matches of above-mentioned Grand Slam Tournaments in 2000 were analysed. In order to describe tactical patterns, court was divided into internal and external zones. Service boxes were divided into internal, middle and external zones. Both matches were compared according to length of rallies, shots usage and differentiation; placement services and returns in winning rallies.

Table 1. Statistical Analysis of two Grand Slam mens' Finals in 2000.

Strokes per rally	Usage of particular strokes (%)			Length of rallies (%)			Rallies (games) won	Serve placement in winning rallies (%)			Returns' placement in winning rallies (%)	
	Serve	Returns	On the net	Short up to 5 strokes	Regular (6-10 strokes)	Long (over 10 strokes)		Internal zone	Middle zone	External zone	Internal zone	External zone
6,0	17	15	3	65	60,7	17,2	57 (68)	25	25	50	43	57
2,6	38	31	17	14	96,7	3,3	68 (88)	50	13	37	28	72

The results show that the length of rallies, proportions between game situations vary according to the surface. During Wimbledon final players were in almost 70% of shots in a serve-return situation. Proportionally, players were 6 times more often on the net (17% of all game situations) but over 4 times less on the baseline (14% to 65%) comparing with Roland Garros final. They were winning 88% of games when serving, comparing 68% during Roland Garros. Also tactical solutions differed according to surface; at Wimbledon they were serving in 50% cases to the "t" but at the Roland Garros in 50% of strokes were placed in an external zone. Also return's placement in winning rallies was totally different. The ratio of winning/losing rally after an aggressive return into external zone was higher, especially on fast courts (72%). Results of the research confirm common believe that different styles and game patterns are used on various surfaces. They also show that the placement of serve into internal zone of service box and return into external zone give better chance of winning a rally on fast courts. Both strokes are decisive for winning matches on fast courts.

G. Torres¹, D. Cabello² and L. Carrasco³

¹Faculty of Health and Sport Sciences, University of Zaragoza, Spain, dcabello@ugr.es

²Faculty of Education, University of Granada, Campus de Cartuja, s/n. 18071, Granada, Spain

³Faculty of Exercise and Sport Sciences, University of Murcia, Spain

The goal of this piece of research was to determine those functional differences existing between tennis and badminton to later identify the most appropriate moment for players to specialize either in tennis or badminton. In order to do so, it was necessary to distinguish the competitive demands required in each of them (Cabello, D. & González-Badillo, J.J., 2003, British Journal of Sport Medicine, 37(1), 18-25).

The study was conducted on 28 subjects aged 16-18 years old; fourteen of them were tennis players and the other half were badminton players. We recorded the anthropometrical measures of the players, their heart rate, and the temporal structure of the game during a competition match in order to compare the data obtained from each group.

The average data we obtained when measuring players were the following: a) regarding weight, values were 59.49 ± 6.10 kg in tennis players and 64.1 ± 4.14 kg in badminton players; b) height was 169 ± 7 cm versus 170 ± 8 cm; and c) the corporal fat percentage was 12.49 ± 2.52 for tennis players versus 13.30 ± 2.35 for badminton players.

Secondly, the data for the temporal structure of the game were the following ones: a) total time was 90 ± 30 min in tennis versus 26.36 ± 12.09 min in a badminton match; b) performance time was 10.1 ± 3.5 s versus 7 ± 1.42 s respectively; and c) rest time was 12.3 ± 4 s in tennis and 12.7 ± 2.98 s in badminton.

Thirdly, heart rate showed a maximum value of 193.6 ± 4.91 bpm in tennis players and 196.1 ± 7.97 bpm in badminton players, and an average heart rate of 158.4 ± 8.51 bpm versus 179.5 ± 7.97 bpm respectively.

The percentage of the average heart rate in relation to the maximum heart rate (average/maximum heart rate) was 80.27 ± 0.88 % in tennis and 91.5 ± 1.96 % in badminton. Statistically significant differences were observed concerning performance and rest time, average and maximum heart rate, and the relationship existing between average and maximum heart rate. Therefore, we can conclude that there were some significant differences between tennis and badminton players, which makes necessary to plan specific training depending on the sport even at these early ages.

Does practising on clay affect level of motor abilities of tennis players ?

P. Unierzyski and E. Hurmik

University School of Physical Education, Tennis Department, Poznan, Poland,
unierzyski@awf.poznan.pl

It is well established that agility and footwork as well as speed and power are important components of tennis players' performance level. Therefore many of the coaches are focused on developing these abilities during training process. The characteristics of clay court game (long rallies, many changes of directions, etc.) encourage to suggest that practising on that surface might help to develop motor abilities and footwork skills on higher level better than practising on other surface e.g. hard courts. The purpose of research was to verify this hypothesis.

The battery of motor ability tests (grip strength, medicine ball throw, 20 m run, so-called figure of shuttle "8" run and sit-and-reach) were performed by 253 Europe's top players 12 years of age, during 9 editions (1993 to 2001) of "La Raquette de Corail", one of the most prestigious tournaments for this age group. Players, who declared that at least 70% of training and competitions they spent either on hard or clay courts, were put to respective "Hard" (n=22) and "Clay" (n=44) groups.

Table 1. Comparison between two groups of players; "hard" which have been practising mostly on hard courts and "clay"; which spent at least 70% of training time on clays courts.

GROUP	Av. Place in tournament	Body Height(cm)	Body mass(kg)	Grip strength(kG)	Med. Ball Th(m)	SB Jump(cm)	20m run(s)	8" Shuttle run(s)	Flexibility (cm)
"Hard" n=22	11,5 ± 8,5	153,8 ± 6,6	40,0 ± 5,6	25,85 ± 5,3	177,6 ± 1,2	3,48 ± 17,9	12,6 ± 0,2	24,0 ± 0,4	24,0 ± 3,7
"Clay" n=44	11,9 ± 8,7	154,9 ± 6,9	40,8 ± 5,8	26,92 ± 4,6	187,9 ± 1,3	3,44 ± 16,1	12,1 ± 0,2	24,0 ± 0,4	24,0 ± 5,8
All players n=253	15,86 ± 8,2	154,0 ± 6,9	40,3 ± 5,1	25,55 ± 4,7	183,4 ± 1,2	3,48 ± 16,7	12,5 ± 0,2	24,0 ± 0,5	24,0 ± 5,6

The results show that both groups were similar as far as height and weight, sport results (average ranking in tournament), playing age and training load is concerned. There were also no significant differences in strength, speed and flexibility. But the difference (significant on $p < 0,01$) in agility/footwork and legs' explosive power (significant on $p < 0,05$) tests was found. This supports the hypothesis that demands of clay court game (many stops, changing directions etc. executed in more repetitions than it is needed on hard courts) favours developing these important abilities. It is still open if it is because of longer rallies (i.e. higher number of repetitions) or rather due to characteristics of the surface.

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A proposal to measure the spin of a ball by digital image analysis

Y. Ushiyama¹, T. Tamaki², O. Hashimoto¹ and H. Igarashi¹

¹Faculty of Education and Human Sciences, Niigata University, ushiyama@birdie.ed.niigata-u.ac.jp
²Faculty of Engineering, Niigata University, Japan

The effects of ball spin are large on tennis and table tennis, because not only the motion in the air but also the motion associated with bouncing and hitting is largely affected by ball spin. It is not easy to measure the ball spin in the play and thus there are very few data of such measurements. In the present work, a digital image analyzing system has been developed to measure the spin of flying balls automatically. A high-speed digital camera was used to take sequential pictures of a ball. The experiment was made in the gymnasium of Niigata University. Test players were two female students. To see the difference in technique of spinning, the onetest player was an experienced player and the other was a beginner.

In the experiment, four halogen lamps were used to lighten the test section and set on the side of the player's dominant hand. The camera was set on the same side. The test table tennis ball with top spin was thrown by a feeder. The player returned the ball with top spin. The test ball (40 mm) had several marks draw randomly. The spin was measured from marks in sequential pictures taken by the camera. The camera is not suitable for storing many pictures. Thus, during the experiment, pictures were transferred to an ordinary camcorder. After the experiment, the images were transferred to PC through a video capture device.

The principle of image analysis is as follows. First, only the part of the object is extracted from the picture in the first frame (first picture). The other parts are not necessary for analysis. In the present case, the part of the object corresponds to the circle which is the projection of the sphere. Next, the part is extracted from the second picture in the same way as in the first picture. Two parts of both pictures are compared. When the ball spins, positions of marks in both pictures do not coincide. By adjusting transformation parameters, the position of marks can be made coincide with each other. The spin is estimated from the change in transformation parameters.

The present results clearly showed that the spin changes drastically after impact. It is found that the spin velocities after the impact are largely different between experienced player and beginner. That is, top spin by the experienced player is much stronger than that by the beginner. It is confirmed that reasonable results are obtained by the present system. The spin velocity is expected to reach 8000 rpm in the case of elite players. To measure such high spin velocities, the speed of the present camera is not enough but another faster high-speed camera is needed.

Influence of gender and tennis court surface properties upon strategy in elite singles

M. Verlinden, J. Van Ruyskensvelde, B. Van Gorp, S. De Decker, and R. Goossens,

Vrije Universiteit Brussel, Faculty of Physical Education and Physiotherapy, Dept. Training and Coaching, CASMAS-Labo, Brussels, Belgium, marc.verlinden@vutb.ac.be

Introduction

Any information on court properties might be useful during preparation as history proves failure of the best players in only one of the Grand Slam tournaments (Borg, McEnroe, Connors, Sampras, Edberg, Becker,...) hence missing the Grand Slam Title. Intuitively the combination "court properties - type of player" is considered as an important cause.

Methodology

CASMAS-methodology (Dufour '93) is used to video-analyse 11 half- and finals of which 5 on grass during the Wimbledon 2000-games [WG] and 6 on gravel during the Roland Garros-games [RG], resulting in the notation of 25.733 events: 15 players, 30 sets, 291 games and 1883 scores. Based upon an observational reliability-study, 12 factors were considered to compare gender and court surface-properties (Mann-W.U-test and T-tests).

Results (Only significant differences are considered)

1. Mean # ball changes per score: overall, women produce 1 more than men ($p < 0.01$). Both ladies and men, RG produce more ball changes than WG ($p < 0.01$).
2. % Forehand ground strokes: in RG men produce more forehand (as opposed to backhand) groundstrokes than women ($p < 0.05$). In WG the opposite is true ($p < 0.05$). Men produce more forehand groundstrokes in RG compared to WG ($p < 0.01$).
3. % Services followed by immediate net-attack: WG show that men more often use this strategy compared to women ($p < 0.01$). In WG, both women ($p < 0.05$) and men ($p < 0.01$) use this typical net-attack-strategy as opposed to RG.
4. % Typical net game behaviour: men play more often this style during WG compared to women ($p < 0.01$). Men play more often on net in WG compared to RG ($p < 0.01$).
5. % Typical baseline behaviour: complementary to net game behaviour.
Scoring behaviour:
6. % Aces: both in WG ($p < 0.05$) and RG ($p < 0.01$) men produce more aces. Both men ($p < 0.05$) and women ($p < 0.01$) produce more aces in WG compared to RG.
7. % Double errors: no differences were found.
8. % Winning services: both in RG and WG, men produce more than women ($p < 0.01$). WG produce for both men and women more winning services as opposed to RG ($p < 0.01$).
9. % Winning returns: during WG, men produce more than women ($p < 0.05$).
10. Efficiency (based upon # of scores):
% Direct scores from net position (passing shots and winners): in WG men produce more than women ($p < 0.01$). Men also produce more during WG compared to RG ($p < 0.01$).
11. % Direct scores from baseline (passing shots and winners): no differences were found.
12. % Indirect scores (= scores made by error of opposite player): during WG, men produce less than women ($p < 0.01$). Men also produced more errors in RG as opposed to WG.

Conclusions

The point of view of Davies ('62) that game-properties of women and men will eventually equalize is still not true. Longer games (fatigue?) may be the cause of augmented number of forced/unforced errors (Vergauwen '98). Gravel may provide more time for players to position themselves into a forehand groundstroke strategy. In grass conditions, elite male players show a preference towards net play strategy. A service-dominance strategy is found especially in grass conditions. Female players do not show disadvantage of body length during service. Restrictions of the study: no time indications, no 3rd dimensional data.

Emotional experience of psychotraumatic situations of top class tennis players.

V. Voronova and Y. Emshanova

*National University of Physical Education and Sport of Ukraine.
Olga.Mizyuk@delta-sport.kiev.ua*

Nowadays sports is a sphere of activity that is characterised by the excessive traumatism [7,10,11]. Traditionally experts pay much attention on studying physical traumas. But special features of psychotraumatic situations influence is comparatively new aspect of this matter [4,6,10,11,12]. The aim of our paper is to study the influence of psychotraumatic situations on effectiveness of the competitive activity of the top class tennis players.

As a result of our research we singled out the main psychotraumatic situations which take place in the professional experience (Table 1)

Table 1: Character of psychotraumatic events

The main traumatic events	Number of situations, %
Defeat	80
Bad training process	10
Injury	10

The results of the analysed data of these researches helped to find out the influence of the type of psychotraumatic emotional experience on the sports effectiveness of professional tennis players in the extreme conditions of the contests. Along with that we need to stress attention to the positive influence of emotional experience on the effective activity in sport. But when you plan psychological accompany, you need to take into account the individual features of sportsmen. The results of our researches point out that with the positive effect of psychotraumatic emotional experience on the effectiveness of sports activity, this experience can influence the athlete's personality both positive and negative.

Therefore, under psychological training with tennis players, you need to pay attention not only on consequences of psychotraumatic situations influence, but on the whole process of its emotional experience.

G. Vučković¹, B. Dežman¹, F. Erčulj¹, S. Kovacič² and J. Perš²

¹ Faculty of Sport, University of Ljubljana, Slovenia, Goran.Vuckovic@sp.uni-lj.si,

² Faculty of Electrical Engineering, University of Ljubljana, Slovenia

The typical characteristics of squash are a high velocity of the ball on a relatively small court and very rapid returns of the ball during a rally, which makes this game extremely dynamic. All this affects players' movements and their external loading during the match. A thorough examination of sportsman's loading is highly important in view of the training activity. Such information provides an essential basis for adequate planning and dosing of loading during trainings, which indirectly improves the efficacy of the training process. The external loading of players during a match of squash was mostly dealt with by Hughes and Franks (1994, Ergonomics, 37(1), 23-29). In their research Hughes and Robertson (1998, Science and Racket Sports II, London 227-234) established that the average length of movement of the top-ranked squash players during a rally was 13.52 m. Regrettably, none of the above researches revealed any information on the total distance covered by the player during a game or throughout the match. Therefore, the purpose of this research is to measure the distance covered by squash players and establish whether there are any significant differences between the winning and the losing side in a game.

The sample consisted of eight top-ranked Slovene, Austrian and Bavarian squash players, who played six matches. All matches were recorded by a fixed SVHS video camera (Ultrak CCD Color KC 7501 CP), with the frequency of capturing input pictures of 25 Hz. The video camera was fixed to the ceiling at the centre of the squash court and calibrated, it did not interfere with the play and could not be hit by the ball. The video-recordings were digitized using the miroVideo DC30+ (Germany) video digitizer hardware with the resolution of 384x576 at 2 MB/s data rate, while the processing was carried out at a resolution of 384x288 pixels. Digital images were processed by the SAGIT/SQUASH computer vision based tracking system (Perš et al., 2001, ISPA 2001, Proceedings of the 2nd international symposium on image and signal processing and analysis in conjunction with 23rd int'l conference on information technology interfaces, Pula, Croatia, 362-365). The testing of statistically relevant differences between the winning and the losing sides in a game in terms of covered distance was based on the t-test for independent samples. In this research the longest distance covered was 1449 m and the shortest only 254 m. According to the results the players cover a 1000 m distance in about 13 minutes. The comparison between the winning and the losing sides in a game shows that the winners run greater distances, but these differences are not statistically significant.

First and foremost, our research concluded that there were no statistically significant differences between the winning and the losing side in a game of squash in terms of the applied indicators. These results are somewhat surprising, as the theory led us to believe that the losing side covers greater distances than the winning one. Such results may stem from the fact that the winning side makes more services and winning returns than the losing one. Last but not least, in the future it would be reasonable to examine these indicators of players' loading by rally and to classify the winners and the losers after shorter completed periods (individual rally).

G. Vučković¹, B. Dežman¹, F. Erčulj¹, S. Kovacič² and J. Perš²

¹ Faculty of Sport, University of Ljubljana, Slovenia, Goran.Vuckovic@sp.uni-lj.si,

² Faculty of Electrical Engineering, University of Ljubljana, Slovenia

Successful playing of squash depends strongly on the appropriate positioning of the player on the basic position (T). In squash the basic position is the area in the centre of the court, located slightly towards the Back Wall. This position optimises the players' chances of making the right move, position properly and then strike the ball. Therefore, both in theory and practice one often comes across the saying: "The player in control of the T position wins it all". In their research McGarry, Khan and Franks (1998, Science and Racket Sports II, London 221-226) examined the radial distance between the players and T as well as the absolute distance between the players. They established that during a rally the players alternately take the T position in an anti-phase relation. This means that in a given moment one of the players is at T and the other at a certain distance from T, and vice versa. Our research focused on establishing the time during which the players stay on the basic position during a match. Therefore, the purpose of this paper is to measure the time during which the players stay at T in a rally and to identify statistically significant differences in the time during which the players i.e. the winners and the losers of individual games, stay on the basic position.

Data were gathered from six matches which were recorded by a fixed SVHS video camera (Ultrak CCD Color KC 7501 CP) with the frequency of capturing input pictures of 25 Hz and covering the entire surface of the court. The video camera was fixed to the ceiling in the centre of the squash court and did not interfere with the play. The video-recordings were digitized using the miroVideo DC30+ (Germany) video digitizer hardware with the resolution of 384x576 at 2 MB/s data rate, while the processing was carried out at a resolution of 384x288 pixels. The results showing the time the players stayed on the basic position during individual games were obtained from the SAGIT/SQUASH tracking system (Vučković, 2002, Master's Thesis, Faculty of Sport, Ljubljana). The testing of statistically significant differences between the winning and the losing sides in a game in terms of covered distance was based on the t-test for independent samples.

The results show high variability in the percentage denoting the time the players stayed on the basic position in the games during one or several matches. On average, in a rally the players stayed at T for $40.2 \pm 6.6\%$ of the time, bearing in mind that the percentage was slightly higher for the winners ($40.4, 26.4 - 51.6\%$) than for the losers ($40.0, 23.5 - 51.0\%$). The data on the period of time reveal that the losers stayed longer at T (168.6 ± 73.9 s) than the winners (166.5 ± 63.7 s). However, these differences are not statistically significant.

The above results are quite surprising, as we expected that the winners of individual games would stay longer on the T position and thus better control the play. One of the reasons for such a short time lied in the fact that all sampled players were equal in ranking. Moreover, it is also possible that the player stays at T when (s)he is attempting to return the ball, since this may also require fast movement through the basic position. Therefore, a future research, apart from establishing the time the players stay on the basic position, could also observe the players' speed at that period of time. Last but not least, it would be reasonable to establish these indicators during a match played by squash players with very different skills.

The expert system of the ping-pong training

Wangjie¹ and Baikaixiang²

¹Wuhan university, ²Wuhan institute of physical education, 430079Wuhan, Hubei, China, Baikaixiang@21cn.com

Ping-pong ball speed is quick, variety is many, skill construction is complicity. In the training of ping-pong, application of modern information technique and various kinds of monitor, the synchronous manifestation of the training process by a certain video equipment, real measuring kinetics and dynamics parameters of the ball and athlete in sports, on time diagnosis and evaluating, helping the athlete to establish reasonableness and cognition of ball character and athlete body, strengthen judgment ability of ball character changing, accelerate to forming process of the skill, ameliorate action's spec and effect, offer service to develop the skill level for the athlete and increase the scientific degree of training.

Research method:

Method of magazine and data; Method of walking to visit the expert; Method of experiment; Method of statistics

Result

- The monitoring system of process the ping-pong training
- The visibility of ping-pong training: connecting output of the general Panasonics recorder to input of colour TV, and the synchronous manifestation of motion image.
- The multi-media demo of skill characteristic and assess: showing of calculate result by the sketch, diagram and data and explaining in detail with voice and word; playing of motion image: play orderly, play reverse, play quickly, play slowly, play steeply, pause; partial action of body joint enlarge to show; playing contrast of two motion images in two windows.
- The technique analysis of the ping-pong training
- The resolution and biomechanics analysis of the action of athlete technique
- The resolution of the action of athlete technique is to record the motion technical image by super-speed recorder and obtain kinetics parameters of the athlete movement, including a few steps as below:

Recording of the motion image

Collecting of the motion image

Collecting of data, calculation of three dimensional coordinates and kinetics parameters

The manifestation of the calculation result

The biomechanics analysis of the technique action

Technique analysis of the prepare action

Technique analysis of the forcibly action

Technique analysis of the end action

-The mechanics analysis of the ping-pong movement

Analysis of ping-pong suffering force and the circuitry of flying

Application of ping-pong touching the table-board and the variety of the sprung speed and angle

Application of ping-pong skill and tactical

Conclusion

- Establishing the fast feedback system of ping-pong training
- Introduce a research method of ping-pong technique analyze
- The detailed expatiating basic mode of ping-pong technique analyze by making use of biomechanics knowledge.

Performance profiles of elite men's squash doubles match-play.

Julia Wells¹, Chris Robertson² and Mike Hughes¹,

¹Centre for Performance Analysis, U.W.I.C., Cyncoed, Cardiff, CF23 6XD, UK

²National Coach, Squash Wales, St. Mellons Squash Club, St. Mellons, Cardiff, UK
MHughes@uwic.ac.uk

The need for analysis of squash doubles has grown over the past 4 years due to its inclusion in the Commonwealth Games (1998 & 2002) as part of the programme. The game of doubles in squash has no research carried out on the patterns of play and coaches are realising that these analyses are necessary to educate themselves, and the players, in the tactics of a game that is new at this level. The game of squash is mainly played as a singles game, especially at a professional level. The aim of this work was to produce performance profiles of elite men's doubles in squash.

Performance indicators were identified between the Welsh National coach and the analyst. These analysis codes were then designed using the Sports Code computerised software package. The matches (N = 5) were analysed post-event due to the detailed information that was notated. An intra-observer reliability test was performed on the data input, which resulted in no significant differences - percentage error differences showed less than 5% error on all categories of variables.

The winner/error ratio's clearly demonstrated the "weaker link" in each pairing, it was also identified that players were forcing errors, rather than hitting winners. The overall rally length was 21.5 shots/rally (the singles game has reduced from 20 to 14 shots/rally over the last 20 years), the majority of rallies fell between 1-30 shots. A shot analysis (see Table 1) showed that large winner/error ratios were induced when playing a cross-court drive, a cross-volley or volley drop, but that poor ratios were incurred when playing a boast or drive from the back of the court. Players produced a higher amount of errors when volleying a low ball (below waist level), whereas volleys played above waist height produced a higher success rate. A high frequency of winners were played off a boast from their opponent, but straight drives or cross-court drives produced large frequencies of errors on the next shot.

Table 1. Some winner/error ratios for successful and unsuccessful shots in elite men's doubles squash play.

	Shot	XDrive	XVolley	Volley Drop	Boast	Volley
W	30	21	23	4	4	4
E	13	14	17	35	21	21

It was concluded that a general definition of the playing patterns of elite men's doubles in squash has been identified, which opens up the possibilities to further develop these analyses in more depth. It is recommended that these methodologies are used in "profiling" performance in the other doubles events in squash rackets, and in other sports that have similar demands.

Analysis and research on the skill of pen-holder using the backhand action of knife grip

Wu Xiuwen, Liu Fende, Tang Jianjun, Gu Zhengping and Shuen Wenxing

Beijing University of Physical Education, Beijing, 100084, China, liuwxl@95777.com

Why is the skill of pen-holder using the backhand action of knife grip probed into?

In the late 1980s, with the rapid development of table tennis, Chinese traditional penhold fast attack play met a potent challenge from European knife grip attacking play (i.e. loop on both sides). The superiority in the first three ball attacks of Chinese penhold fast attacking play became weaker and weaker. The opponents often use the tactic of either attacking backhand rally or left attacking after lift to the right due to the lack of attacking ability in particular so that Chinese penhold fast attack player fell into a passive position. In winter in 1990, Liu Guoliang, a young penhold fast attack player, began to make an audacious innovation in the skill of backhand attack, pen-holder using the backhand action of knife grip. That skill moved towards mature step by step through hard working and exploration. He defeated many world famous table tennis players such as Waldner, Jin Zezhu and Jin Chengxi in the competition held in China in 1992, which drew table tennis circles home and abroad attention. Thereafter, more and more players imitate that skill such as Ma Lin and Yansen, who became very elite players using the backhand action of knife grip. This article analyze and research into the skill of pen-holder using the backhand action of knife grip in order to provide references to the table tennis circles.

Subjects: to analyze and research into the skills of Liu Guoliang's, Ma Lin's and Yansen's using the backhand action of knife grip (backhand fast drive, backhand drive stroke, countering loops, drive stroke and etc.)

Methods: to use a computer to analyze their skills of using the backhand action of knife grip:

1. in order to fully display the characteristics in time and space of displacement of two relative movements---ball flying and attacking action, we use the techniques of memo motion photography and still photography during shooting and video-making, which make the transient attacking action be orientated in space and be displayed continually in time; therefore, relatively accurate qualitative analysis is made. (see video tapes).

2. On a basis of videos of memo motion and still photography, the computer is used to describe the attacking orientation, amplitude of swing and the data about the changes of joints' angle when attacking and its spatial locus; therefore, a relatively quantitative analysis on the skill is made. (see video tapes)

Conclusions:

1. The skill of using the backhand action of knife grip can develop the potential of many muscles of arms.
2. The skill can make upper limb whip more fully.
3. The skill can make the surface of bay recover loops better.
4. The skill makes the ball leave the bat faster and make players take wider court into account.

Application of game analysis system during Thomas Cup & Uber Cup Finals 2002

Xie Wei

Sports Medicine & Research Center, Singapore Sports Council, XIE_Wei@ssc.gov.sg

To increase the awareness and understanding of the Badminton game, a computerized game notational analysis system was developed to appropriately display the various captured technical data of badminton matches on the spot and video footages. The analyzed data are useful for coaches and players to see feedbacks and also prepare for future games. Furthermore, it is very helpful for audience to understand the techniques and tactics used by players in the competition. In turn, the game will be more interesting and attracting to the viewers. In May 2002, the Badminton Games Analysis System was applied during the Thomas & Uber Cup Finals, to provide real-time data for coaches, players, media centres (reporters) and overlaying on live TV broadcasting.

During the competition, the system was located beside of the court. A computer network was also set up to connect the live TV broadcasting system and the station of TV commentators. The operator input the selected data of matches into the system, and the processed data was sent to the real-time display computers, printers and the overlay device of the TV broadcast system for live broadcasting through the network. The functions of the system are summarized as follows: (1) Collect data on the spot or by video with different models to provide various data; (2) Calculate up to hundreds games for game analysis, countmeasure analysis and trend analysis; (3) Database; (4) Provide the data to overlie on live video for broadcasting; (5) Supply data (display and print) to coaches, players, commentators and reporters.

A total of 198 games were collected (101 games of men's singles and doubles, 97 games of women's singles and doubles). Besides live TV broadcasting and feeding back the technical data to coaches, the data of rallies is also statistically analyzed and the data of attacking techniques is compared one with another team to see effectiveness of each technique in the matches

Receiving technique of rotating ball (Motion of upper limb and muscular activities)

K. Yoshida, K. Sugiyama and M. Murakoshi

Shizuoka University, Japan, shkyosi@ipc.shizuoka.ac.jp

The flick stroke in table tennis is a returning technique with which you return a rotating ball quickly after the ball bounces on the court. Dynamics of the flick stroke have been studied by some researchers, but physiological studies of the flick stroke have been very few so far. As a result, the muscular mechanism which enables intended motions is not well understood. In this work, the motion of joints of the upper limb and muscular activities were measured in the case of fore-hand flick strokes.

Five university students and a coach cooperated with the authors for the present test. Among these 5 students, one (Player A) is an elite player, a member of the Japanese national team of Universiade. Other 4 students (B, C, D and E) are average players. All players used shake-hand rackets. In the test, the coach acting as a server, sent a service ball and students returned it by flick stroke. The service balls were controlled to hit the receiver court in the circle of radius 20 cm, the center of which is 50 cm from the end line and 40 cm from the right side line. The receiver was required to return the balls in the 25 cm radius circle, the center of which is 95 cm from the net and 30 cm from the left side line on the server court. Two cases with and without back-spin were examined. The receiver was informed of whether the service ball spins or not before hitting. The tests were repeated for each case until the receiver succeeded in returning the ball precisely more than 5 times as was required. In practice about 10 trials were necessary for each case.

Measurements were made for various muscles in the upper limb. Muscular electric discharge was measured by a surface dipole dielectric method. After the treatment for skin resistance, miniature bio electrodes of 12 mm diameter were set along the line of muscles following the Zipp method. The spacing between electrodes was about 20 mm. Angles of the elbow joint and wrist joint were measured by a goniometer. Bend and stretch as well as rotation of joints were measured. Acceleration sensors were installed on the table and racket to measure impact forces at the moment of bouncing. Using a data analyzing system and PC, all the analog signals were sampled at the sampling frequency 1 kHz and converted to digital data for further processing. Also, player's motions in the test were recorded by a digital video camera.

The following results are shown. First, the time length from the moment when the ball bounces on the receiver court to the moment when the receiver hits the ball is shown. It is found that the time is about 0.2 second for all the players regardless the conditions of ball rotation and player's quality. Second, variation of muscular electric discharge and angles of joints against the time is shown. The results of the starting time of muscular electric discharge of various muscles are compared. Third, the time length from the starting time of muscular discharge to the moment when the receiver hits the ball is shown for various muscles. Significant difference is not observed between the two cases of back-spin and no-spin, although the direction of racket surface and direction of swing differ between the two cases.

Table tennis after the introduction of the 40mm-ball and the 11-point format

Hui Zhang and A. Hohmann

University of Potsdam, 14469 Potsdam, Germany, ahohmann@rz.uni-potsdam.de

The differences between a 40mm- and a 38mm-ball in physics as well as between an 11- and a 21-point game format in theory have been extensively studied since the ITTF has reformed table tennis rules. In contrast, possible differences in playing techniques and game tactics have not been evaluated yet.

Methods: in the present study, 38 international men's singles playing with a 40mm ball and an 11 point format, and another 38 international men's singles playing with a 38mm ball and a 21 point format were systematically assessed. The match analysis of the two types of the game concentrated on four categories: (1) game action (serve, return, offense, block, and so on), (2) stroke position, (3) stroke direction, and (4) stroke technique. The objectivity of the game observation system was determined by the common variance between the results of two independent observers, and Cohen's kappa.

Results: the common variance between the results of the two observers varied between 91.9 percent ($\kappa_{obj} = .96$) for the stroke technique, and 97.4 percent ($\kappa_{obj} = .99$) for the stroke position. Cohen's kappa varied between .91 (technique) and .97 (stroke position). Except for the following three points, there was no difference in table tennis tactics between 40mm-ball/ 11-point match and 38mm-ball/ 21-point match:

1. The analysis of the *game actions* showed that the player's return of the opponent's serve was executed more conservatively in the 40mm-ball/11-point match than in the 38mm-ball/ 21-point match. That means that the return less often forced the opponent to use a defensive action ($T = -2.39$, $p < 0.05$). The service with a long ball to the opponent's backhand side was less used in the 40mm-ball/ 11-point match than in the 38mm-ball/ 21-point match ($T = -3.38$, $p < 0.01$).
2. Concerning the *stroke direction*, the strike from the long forehand side to the long forehand side of the opponent was higher in the 40mm-ball/ 11-point match, than in the 38mm-ball/ 21-point match ($T = 2.09$; $p < 0.05$). In contrast, the rate of the strikes from the long forehand and backhand side into the direction close-to-the-body of the opponent was lower in 40mm-ball and 21-point games ($T = -3.71$, $p < 0.01$; resp. $T = -2.05$, $p < 0.05$).
3. The rates of the *stroke techniques* topspin ($T = 3.78$; $p < 0.01$) and attack ($T = 2.60$; $p < 0.05$) following the opponent's topspin was increased in the 40mm-ball/ 11-point matches.

Discussion: the introduction of 40mm-ball had changed the physical character of the ball speed and rotation. 11-points match had shortened the game time and accelerated the game rhythm. But the changes of these two aspects have led to only small changes in tactics. On the other hand, 11-points match could affect the mentality of the players more than the technique and tactics.

Zhang Xiaopeng

National Research Institute of Sports Science, 11 Tiyyuguan Road, Beijing, China 100061
pingpong@public.bia.net.cn

According to the statistics by the International Table Tennis Federation (ITTF), 7 to 8 rallies in one point in the table tennis matches will make spectators applause; over 10 rallies will form a warm atmosphere during the match. But, there are only 2 to 3 rallies in average in one point of the present matches. The short rallies were determined most by the obscure services with high speed and spin among others. So, the ITTF decided to change the rules from the beginning of 1st Sep., 2002 to make the services open and obvious. The study was entrusted by ITTF for the sake of making the rules more clear for the umpires to judge in the matches and the players to practice before the date when the new rules are put into effect. 5 video cameras were used in the study to take pictures of 8 kinds of the present services by Chinese 11 world champions from 5 angles. Based on the rules' description, the evaluation standard was established. Each service was analyzed by the contrast of 5 pictures taken from the 5 angles in one screen. The requirements of the new rules in the matches have been put out.

The results are as follows:

1. The free hand should be lower than the hitting point.
2. The trajectory of the toss by free hand should be nearly vertical.
3. The angles between the upper body and the end line of table should be less than 180 degrees.
4. The upper body should not be bent forward too much.
5. The hitting point is better on the height of the abdomen.

Until now, the results of the study have been delivered by ITTF on videotapes to the national associations for reference by umpires and players.

Zhang Ying Qiu

Xiao Qiu Department, Beijing Sports University, Beijing, China 100084
Zhangyingqiu561.student@sina.com

Adolescence is the golden period for the players to improve their physical fitness, to master basic skills and to raise their training level. Whether the players have a sound foundation of their physical fitness and basic skills has a lot to do not only with their own future development but also with the future development of table tennis in China. Sport training is a complicated process and it is also the most important approach to the improvement of sports skills. Getting the best results depends on both organizing the training process scientifically and controlling the whole training process effectively. Therefore, coaches must obtain feedback information of the players' current condition through various objective and effective testing means, and make a comparison between the current condition and goal condition to find out the difference so as to regulate and control purposefully the training methods and means, in order to realize the transition from current condition to the goal condition. There are many papers on studying the physical fitness of the players at present. But most of the papers focus their study on one single factor and one aspect, while only a few data are available and the skills of the players are comparatively low. Therefore, it is necessary to conduct a thoroughgoing and careful study on the physical fitness training and evaluation of the Chinese elite players.

Subjects: 48 males and 48 females were chosen as subjects from Chinese active paddlers in 1997 and the players getting good results in the preliminary contests of Chinese Excellent Players Investigating Competition from 1998 to 2002.

Methods: (1) Testing Data: all the data were controlled by the officials from Chinese Table Tennis Association while the graduate students of Beijing Sports University carried out the test so as to make sure the data were precise and believable. (2) SPSS software was in use and data processing was carried out by Prof. Qi Guoying, Statistics and Measurement Department of Beijing Sports University, so as to make sure the data were precise. (3) The indexes were screened by factor analysis, and the effective regression models were established by using the method of multiple regression. The test contents and evaluation methods were then determined. (4) The test contents and evaluation methods determined by this paper were used in the test during the Chinese Excellent Players Investigation Competitions from 1998 to 2002, and they were revised whenever necessary according to the problems arisen and the results in the competitions, so they are more practical and scientific.

Conclusions (1) The physical fitness indexes of the three events, 3000 meters running, side-slip-step, handgrip, formulated by this paper can display the physical fitness and training level of the Chinese excellent adolescent paddlers, and the testing method is reliable and feasible. (2) The evaluation method developed by this paper is a easy to notice, simple, practical, precise, scientific comprehensive evaluation method, which can be used to understand the physical fitness of the players, to check training results and to provide objective basis for making training plan, controlling training process effectively, and selecting players. (3) The testing method and evaluation system developed by this paper are basically perfect, because they were used in the testing, regulated, and revised during the competitions for Chinese Excellent Adolescent Players from 1998 to 2002. Whether the adolescent players can enter for second stage of the competitions depends on passing the test.

The influence of no-shelter service on table tennis tactics and skills

Zhang Ying Qiu and Liu Feng De

*Xiao Qiu Department of Beijing Sports University, Beijing, China, 100084,
Zhangyingqiu5@1.student@sina.com*

The International Table Tennis Institute has carried out a series of reformation to widen the cover area of golden middle winners and to improve suspension of match results. Another impulsion, no-shelter service, comes to table tennis matches on September 1 this year after bigger ball and 11-score rule. Hence, we have to make sure what changes have happened on table-tennis matches because of no-shelter service and find out the new rules. Then have our training adopt to the changes so that keep the status of Chinese team in the international table tennis field.

This paper took the brunt players on the national team as subjects. The kinescopes of their performance in the Asia Sport Games and the World Cup are calculated statistically for tactics and skills. Then compare those ones to their former performance when no-shelter service rule did not been carried out. From the results of the compare, we learn more clearly about how no-shelter service changes the players' tactics and skills on the states of servicing, attacking after service, receiving and confronting each other. We can also scientifically analysis what infection those changes bring to velocity, strength and circumrotation of ball as well as to the skills of servicing, confronting each other and receiving. It supplies theory basis and scientific data for the national team to adopt the new situation as soon as possible, and maintains the leading status of our players in the international table tennis field.