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TESTING, PERFECTION AND MONITORING OF MOTOR ABILITIES OF TABLE TENNIS PLAYERS

Abstract

The study of table tennis structure represents the first step towards its scientific view working with top table tennis players.

Physiological aspects of modern table tennis are analyzed and defined.

The battery of tests is chosen on the bases of the analysis of structure and physiological requirements of modern table tennis.

Period of testing – during one competition season (July – may (June)) the following time points of motor abilities testing:

- *Summer preparations (work on basic motor abilities) two testing (in the beginning and at the end of the preparations)*
- *Testing before the beginning of the competition season*
- *Winter preparations (two testing (in the beginning and at the end of the preparations)*
- *Testing before preparations for big competitions (World and European championship)*
- *Testing at the end of the competition season*

The influence of motor abilities on the game results – the analysis of the test results of motor abilities during the longer period of time (national team of Serbia and Montenegro) and comparison with the results achieved at big competitions and rank of the players at the World Rang List:

- *comparison and analysis of the results of Ilija Lupulesku, Slobodan Grujic, Aleksandar Karakasevic and Rade Markovic*
- *the analysis of the results of Erdelji Ana-Marija (European cadet champion in 2000 and in 2003 the final junior year)*
- *the analysis of the results of the male senior national team of India in the beginning of the competition season of 2001/2002 and before the performance at the Commonwealth Games 2002 (the bronze medals in team, pair and single competitions)*
- *the analysis of the results of Marko Jeftovic and Pete Zolt (key players of the junior national team of Serbia and Montenegro before the European championship in Novi Sad 2003 (11th place as team) and the European championship in Budapest 2004 (second place (silver medal) as team)*
- *Comparison senior, cadet and junior players*

Key words: *table tennis, motor abilities, tests, monitoring*

1 Introduction

Modern table tennis demands from players optimal psychophysical qualities, since a time when good technique and tactics belong to past. The study of table tennis structure represents the first step towards its scientific view working with top table tennis players. The process of training contains several elementary aspects - technique, tactics and strength, physical, then psychological preparation and the process of forming a sporting character. These elements form a unique whole in the process of training which leads to top form. There are connections between some of these elements which, when synchronized represent condition for the optimal realization of all abilities. Analyzing the matches of leading World and European competitions, we can determine motoric needs in modern table tennis. During one match a player makes about 100-110 lateral (side) movements (hops - stressing the left-right direction), about 50 so-called deep

movements (back and forth direction), about 90-100 forehand swings, and about 60-70 backhand swings (Djokic, Z.: "Basic and special physical preparation of top table tennis players", ITTF Sport Science Congress, Paris, 2003).

So, the dominant motor abilities in modern table tennis are: strength, speed, agility, coordination, precision, endurance and flexibility.

Also, using new technology we determine and physiological aspects of table tennis players during matches (Djokic, Z.: "Heart rate monitors in table tennis", ITTF Sport Science Congress, Paris, 2003). During the table tennis match the increasing of the heart beats is noticed as the game goes on. So the maximum value of the pulse rate marked through the ending and at the moments which decided the winner of the set and match. The average values of the pulse rate during the match were from 162 to 172 beats per minute (6 time measurement of the matches at official competitions – European League). From this information we can make conclusion that table tennis game is more than 75% of the game in anaerobic zone, and at the end of the game near and in maximal zone.

2 Methods

Tests and analysis of motor and functional abilities of players were done during period from 1998 – 2005. Data base of this data were used. These data were taken in pre season period (summer and winter National Team preparation), on start and during prepare for World, European Championships and Olympic Games.

2.1 Participants

Sample of players were the National Teams (all categories) of Yugoslavia-Serbia&Montenegro – 98 players. Also, some of results were taken in season 2001/2002 with senior National Team of India – 12 players.

2.2 Procedure

All results were analyzed as a group results and as individual results. Standard statistical methods were used:

- Arithmetic Middle
- Standard Deviation
- Variation (Maximum and Minimum results)
- Simple and relative Frequency

3 Results

For the establishment of the initial condition of a player the tests for basic and specific motor abilities were applied. For that purpose the most adequate were collection of 15-20 tests for the estimation of basic motor abilities and 3 tests for estimation of specific motor abilities (related to the table tennis itself).Motor abilities tests are so-called field in stead of functional (laboratory). For the estimation of all relevant motor abilities, which will be explained below, adequate standardized tests were made, namely, the basis of data exist and are formed in last 8 years, to which the results can be compared. With the analysis of the got results we get the actual picture of the condition of the player, the basis for planning and programming the training process.

Functional abilities:

1. Astrand test (ergocycle) – Maximal Oxygen Uptake (VO2 max)
2. Conconi test (treadmill or athletic track) – Lactate Threshold

Basic motor abilities:

Strength – General

1) Push Up Test (PUSHT)
2) Sit Ups Test -30 sec (SITUT)
3) Curl-Up Test (CURLT)
4) Medicine ball javelin quadratlon
   These entire tests are standardized.

Table 1 *Results (average) of tests for evaluation of general strength*

Teams (YUG)	**Age**	**PUSHT**	**SITUT**	**CURLT**
Men Senior	27.0	30.8 (56)	32.5 (38)	92.0 (142)
Women Senior	22.6	17.3 (27)	21.3 (35)	65.8 (105)
Junior boys	15.6	26.5 (41)	32.0 (35)	65.0 (93)
Cadet boys	13.6	11.0 (20)	26.2 (28)	49.4 (67)
Junior girls	16.5	10.3 (21)	26.3 (31)	83.5 (109)
Cadet girls	14.0	11.0 (21)	27.0 (30)	60.2 (200)

* - maximal result in test in data base.

Strength – explosive

5) Standing Long Jump Test (SLJUM)
6) Triple Long Jump Test (from spot) (3JUMP)
7) Sergeant (vertical) Jump Test

Table 2 *Results (average) of tests for evaluation of strength - explosive*

Teams (YUG)	**Age**	**SLJUM**	**3JUMP**
Men Senior	27.0	227.6 (265.0)	6.63 (7.35)
Women Senior	22.6	177.5 (198.0)	5.40 (6.00)
Junior boys	15.6	224.0 (235.0)	5.80 (6.05)
Cadet boys	13.6	181.7 (215.0)	5.21 (5.80)
Junior girls	16.5	167.6 (180.0)	5.05 (5.90)
Cadet girls	14.0	174.2 (185.0)	5.10 (5.50)

Speed and Power

8) 10 meter sprint test (start is from squat position backward in stead of finish line)
9) 30 m speed test
10) Flying 30 m speed test

Agility

11) 6X4m Side Movement (6X4MS)
12) Hexagonal Obstacle Agility Test
13) Two triangle Test (2TRIT)
14) Lateral Change of Direction test

Table 3 *Results (average) of tests for evaluation of agility*

Teams (YUG)	**Age**	**6X4MS**	**2TRIT**
Men Senior	27.0	10.04 (8.50)	9.31 (8.80)
Women Senior	22.6	11.21 (10.94)	10.00 (9.65)
Junior boys	15.6	10.14 (8.86)	9.95 (8.98)
Cadet boys	13.6	10.48 (9.19)	10.88 (10.13)
Junior girls	16.5	10.86 (10.48)	11.14 (10.67)
Cadet girls	14.0	10.31 (9.91)	11.18 (10.81)

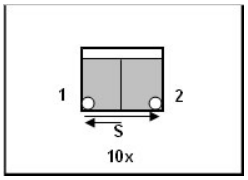
Flexibility & Balance

15) Sit and Reach Test
16) Static Flexibility Tests – Hip&Trunk, Shoulder&Wrist, Trunk&Neck

Specific (table tennis) motor abilities tests

1) Specific test (speed of arm movements) (TAPP1)

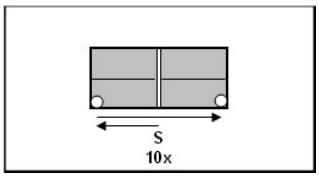
Picture 1 *TAPP1*



Start position is near the table in front of central line (S). Player choose which side to start. With different hand from the side of marker he touch marker (left side with right arm). Measure of time start with sound signal for start, the end of test is after player makes 10 contacts with marker.

2) Sideways TT movements (TAPP 2)

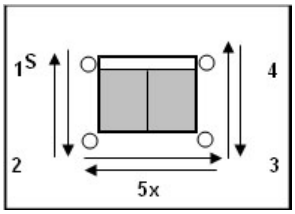
Picture 2 *TAPP2*



Start position is near the table in front of net line (S). Player choose which side to start. With different hand from the side of marker he touch marker (left side with right arm). Measure of time start with sound signal for start, the end of test is after player makes 10 contacts with marker.

3) Combined footwork movements (left-right-forward-backward) (COMMV)

Picture 3 *COMMV*



Start position is near the table in front of net line (S). 1-2 backward movement; 2-3 side movement; 3-4 forward movement, and back – it repeats five times. Measure of time start with sound signal for start, the end of test is after player make cross the hypothetically net line for the fifth time.

Table 4 *Average values of specific tests*

Teams (YUG)	**Age**	**TAPP1**	**TAPP2**	**COMMV**
Men Senior	27.0	3.18 (2.91)	7.72 (7.25)	13.02 (12.69)
Women Senior	22.6	3.81 (3.48)	8.87 (8.71)	15.02 (14.88)
Junior boys	15.6	3.20 (2.97)	8.05 (6.88)	13.52 (11.46)
Cadet boys	13.6	3.94 (3.21)	9.20 (7.76)	14.73 (13.33)
Junior girls	16.5	3.88 (3.50)	8.99 (8.95)	15.85 (15.01)
Cadet girls	14.0	3.73 (3.50)	9.20 (8.97)	15.60 (14.92)

The battery of tests is chosen on the bases of the analysis of structure and physiological requirements of modern table tennis.

Period of testing – during one competition season (July – May (June)) the following time points of motor abilities testing:

Summer preparations (work on basic motor abilities) two testing (in the beginning and at the end of the preparations)

This is the only period which gives use enough time to work on the basic abilities. Usually, it last from 14-21 days. In first 7-10 days, we don't include table tennis in training schedule. First two days are provided for battery of motor tests (and if it is possible, functional/medical tests). Full battery of tests should be done. Control tests should be done about two days before prepare finish (reduced number of tests). Day before control test, we give light aerobic training.

Testing before the beginning of the competition season

In period immediately before start of championships (competition season) some of the functional tests (as VO2max, Lactate Threshold) and some specific tests (explosive strength and table tennis tests), should be done. Not more than 5-6 tests. These tests can be again repeated during the season.

Winter preparations (two testing (in the beginning and at the end of the preparations)

Usually, for this prepare we have 7-10 days before New Year (after the end of championships), and eventually 7-10 days after New Year holidays. In first part of prepare, we used to do battery of tests and not to involve table tennis practices in first 3-4 days. Control test should be done at the end of the second prepare period.

Testing before preparations for big competitions (World and European championship)

Period from about 20-25 days is ordinary for National Team prepare before European and World Championships (for Olympics we have much more time, about 2 month prepare). Tests are done in first 3 days of prepare.

Testing at the end of the competition season

At the end of the competing season, tests should be done. Especially for players of National Team. So, active recovery and rest time is on them, and at the gathering of National Team at the summer prepare, we have complete picture about their level of fitness, and also, about quality of their break from playing.

The influence of motor abilities on the game results – the analysis of the test results of motor abilities during the longer period of time (National Team of Serbia and Montenegro) and comparison with the results achieved at big competitions:

Comparison and analysis of the test results of Lupulesku Ilija, Grujic Slobodan, Karakasevic Aleksandar and Markovic Rade

These players were the best senior in period 1998-2005 (in period that data base of motor abilities exist). In this period they achieved very good results. 1998.-EC medalists; 2000.-EC medalists, ¼ finalists Olympic Games; 2001.-Mediterranean Games medalists; 2002.-EC medalists 2003.-EC medalists 2004.- ¼ finalist Olympic Games; 2005.-Mediterranean Games medalist, EC medalists.

Table 5 *Results (average) of motoric and functional tests*

test	Lupulesku I.	Grujic S.	Karakasevic A.	Markovic R.
PUSHT	21	29	15	38
SITUT	35	38	31	34
CURLT	53	114	70	120
3JUMP	7.03	7.24	6.54	7.30
6X4MS	9.94	10.21	10.50	8.92
TAPPH*	4.66	4.37	4.84	4.59
VO2max	56.50	64.37	42.74	62.91

* TAPPH – classic Tapping Test

It is important to know that in this period Lupulesku was at the end of his playing career in Yugoslav Team. So, his results don't represent his abilities, because he was known as one of the most efficacy player in area of motor abilities. Also, Karakasevic is always under standards in motor and functional abilities, but, studying of his training and playing demands, he's more rational in stead of other players, with much less movement, and energy expenditure. Grujic and Markovic are always in high level of all motor and functional abilities.

Analysis of the test results of Erdelji Ana-Marija (European cadet champion in 2000 and in 2003 the final junior year)

Player Ana Marija Erdelji won European cadet single champion title at EC 2000. In Bratislava, in Team competition as junior she won bronze medal at EC 2003. in Novi Sad. Complete National Team is in system of monitoring and development of functional and motor abilities since 1998.

Table 6 *Results of tests in season 2001 and 2003*

	test	2000-1	2000-2	2003
strength	**PUSHT**	3	8	6
	SITUT	30	31	25
	CURLT	159	200	55
strength explosive (m)	**SLJUM**	1.63	1.74	1.70
	3JUMP	5.50	58.5	5.80
agility (sec)	**6X4MS**	10.49	10.40	10.48
specific (sec)	**TAPP1**	3.92	3.50	3.88
	TAPP2	9.16	8.95	9.09
	COMMV	15.87	14.92	15.95
endurance (ml/kg)	**VO2max**	43.40	48.18	45.57

In season 2002/2003 (first half of season) Erdelji had injury of shoulder. This is one of the reasons why results are on lower level that usual, but also, it is obviously and influence of this to final results at competition.

Analysis of the test results of the male senior National Team of India in the beginning of the competition season of 20001/2002 and before the performance at the Commonwealth Games 2002 (bronze medalists-Team, double and single)

Initial tests were done in December 2001. Control tests were done in March and July 2002 (C. Games were held in August).

Table 7 *Results (average) of motoric and functional tests in 2001 and 2002*

	test	2001	2002
strength	**PUSHT**	34.8 (38)	39.5 (47)
	SITUT	27.8 (34)	29.8 (35)
strength explosive (m)	**SLJUM**	2.15 (2.50)	2.21 (2.52)
	SARDZ	0.49 (0.69)	0.51 (0.70)
agility (sec)	**6X4MS**	11.04 (10.57)	10.68 (10.21)
specific (sec)	**TAPP1**	3.82 (3.35)	3.80 (3.27)
	TAPP2	9.39 (8.68)	9.28 (8.70)
	COMMV	15.18 (14.91)	15.07 (14.89)
endurance (ml/kg)	**VO2max**	57.13	59.18

In stead of Yugoslav players, specific abilities and explosive strength (specifically of the upper body) were inferior. In period of six month we compensate this deficiency with systematic work and control in area of physical prepare.

Analysis of the test results of Jevtovic M. and Pete Z. (key players of the junior National Team of Serbia and Montenegro before the European Championships-Novi Sad 2003 (11th Team) and the EC-Budapest 2004 (2nd place) Team)

These two players are in system of monitoring and development since 1999. It is interesting to compare results of functional and motor tests in year 2003 and 2004, to see where is quality difference which cause achieving great result at European Championship in Budapest.

Table 8 *Results of motoric and functional tests in 2003 and 2004*

		Pete Z.		Jevtovic M.	
	test	**2003**	**2004**	**2003**	**2004**
strength	**PUSHT**	8	20	28	34
	SITUT	24	28	27	30
	CURLT	44	65	80	93
strength explosive (m)	**SLJUM**	1.90	1.97	2.10	2.21
	3JUMP	5.70	5.90	5.80	6.02
agility (sec)	**6X4MS**	10.17	9.76	10.18	9.88
specific (sec)	**TAPP1**	3.73	3.71	3.69	3.45
	TAPP2	9.06	8.92	9.12	8.15
	COMMV	14.52	14.15	14.22	13.89
endurance (ml/kg)	**VO2max**	46.86	53.22	53.4	61.02

These two players in one year considerably increase their motor abilities, also one of the reasons was and playing full competing season in senior National championships as key players in their clubs.

4 Discussion/Conclusion

Tests of motor abilities are also with functional tests integral part of every serious work in modern sport. From these tests we can make conclusions, guide our training program and monitor development of our players. Especially this procedure is necessary when we work with National Teams.

After test results analyses, we can directly and with high efficacy to influence to development of our players. It is important at the beginning of season, and also, at the beginning of final preparation for big competitions.

Forming database for all categories is necessary for quality evaluation of results. We can also; check some new types of training and their effects to player's abilities.

Some special type of specific practice which have influence on improving of physical prepare level through techical&tactical elements (so called "transformation" training) is in progress. After enough proof of their efficacy (on adequate sample of players) they will be published. Monitoring and check of their efficacy will be through this battery of tests. The aim is that this type of specific physical conditioning can start in early age of players, with less time for practice and more efficacies.

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