

Designing and Calibrating Specific Tests for Counter-Attack Skills in Junior Table Tennis Players using Modified Electronic Ball Canon (Table Tennis Robot)

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Table tennis has evolved greatly during the last decade of the twentieth century and the third millennium opens up new horizons for this evolution through investing modern technologies that can be applied to help developing training programs that aim at higher levels of performance to elevate the physical, technical and tactical levels of table tennis players to the world class level. The current research aimed at designing specific tests to measure the ability of counter-attack in table tennis juniors less than (18) years using the Table Tennis Robot and identifying standardized levels and percentiles for these tests. The researcher used the descriptive (survey) approach on a sample of (112) junior table tennis players. Most important findings of this study are the design of these tests besides deriving their standardized levels and percentiles.

Key words: counter-attack – standardized tests – percentiles.

Introduction:

Training process has been developed greatly in our modern age according to evaluation and assessment approaches, which has a clear effect in this development and a major role in diagnosis, classification, prediction, selection and direction. It is so important that it has become the solid base of planning sports training and one of pillars that carry the training process as a whole. Thomas Kurz & Mikolaj Zagroski (2007) indicated that evaluation in sports training has an effective role in programs to achieve its desired goals and it is important to identify the strengths and weaknesses of both the player and the program, besides identifying progress, players' training status and their physical, technical, tactical and psychological characteristics. (21) Djokic Zoran (2007) noted that calibrated tests is a very useful means of evaluation in table

tennis for both coaches and players as it helps them increasing the efficiency of training, forming a data base for each player and his/her progress and using it in the beginning, middle or end of the season or even in upcoming years. (5)

Laila Farahat (2001) indicated that tests that are designed and calibrated using a sample representing the beneficiaries' community are more useful than those that are designed and calibrated using a sample representing another community, no matter how similar are the two communities. It is one of the most important tools that increase the interest in practice and training to achieve higher performance levels. (9)

Table tennis has evolved greatly during the last decade of the twentieth century and the third millennium opens up new horizons for this evolution through investing modern technologies that can be applied to help developing training programs that aim at higher levels of performance to elevate the physical,

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technical and tactical levels of table tennis players to the world class level.

Attack tactics are now dominant in table tennis and give the opportunity to win the point in the first five balls and increasing the offensive nature of the match. This is in agreement with Sherif Saleh (2002), Wang Dazhong (2005), Baca Arnold (2007), Escobar-Vargas (2007), Hao Zhe (2007), Wang Yali (2007) and Jili Song et al (2009). (17 – 23 – 4 – 8 – 10– 24 – 12)

Kondric Marin et al (2007) indicated that any coach can judge the higher levels players in table tennis through attacks or counter-attacks using loops with different spins to produce the desired speed and spin. The importance of the loop has increased after the modifications made by (ITTF) that increased the ball diameter to 40mm and its weight to 2.7g. This increased the difficulty in dealing with the ball as a result of the decrease of its flight arch. Tepper & Glenn (2006) noted that this new ball has a speed that reached 180km/h and its spin was more than 150 cycle/second (13– 20).

The researcher thinks that due to the changes of flight arch of the new ball, as a result of the decrease of both the size of the ball and its flight arch, the table tennis junior player faces some difficulties in initiating counter-attacks during matches. The modified ball canon (Table Tennis Robot) can specify the spin velocity, volume and type besides the length of the ball flight over the table. The researcher thinks that it is important to make this study to enhance the performance levels of junior table tennis players.

The researcher reviewed several studies that designed tests for attack and loop. These studies include ETTA (1999), Magdy Shawky (2002), Djokic Zoran (2007), Mohamed Abd El-Gawad

(2009) and Manoj Purashwani et al (2009). (6 – 8 – 5 – 1 – 14)

The researcher found that past tests are designed to measure speed and accuracy of attack basic skills only and not the counter-attack skills. These studies used the old ball canon with fixed speed and location and not the modified one that is capable of changing speed with its remote control unit. Also, these studies did not identify spin velocity, volume and type or its flight length over the table for less than (18) years junior players.

According to the researcher's expertise as a coach and head of coaches committee and secretary of the scientific committee in Egyptian Table Tennis Association (ETTA), and from watching several national and international championships and identifying the past tests from reviewing the related literature, he found that evaluating counter-attack skills in table tennis needs to be developed according to the most recent modifications in the game rules and regulations and according to the requirements of speed, spin, altitude and directions. All these requirements necessitate that table tennis players should master counter-attack from all distances and angles of the racquet and table, no matter the distance of the player from the table is. This led the researcher to design tests that measure the ability of counter-attack in junior table tennis players using the modified ball canon that is considered one of the most recent training technologies in table tennis. The device can change directions, speeds and spins of the ball so that its results are more stable and valid than human testers. It also enables us to specify percentiles for tests.

Mohamed Sobhy Hasanain (2003) indicated that standards are values representing the performance of specific community in a specific test. Or, they are tables used to interpret test scores and identify standards that turn row data

into standardized data to put a level for test scores. Mohamed Hassan Alaawy (2008) noted that there are three major types of standardized scores: self score value, (t) value and percentile. (11 – 3)

Aims:

- 1- To design specific tests to measure the ability of counter-attack in table tennis juniors less than (18) years using the modified ball canon.
- 2- To put standardized levels for the tests measuring the ability of counter-attack in table tennis juniors less than (18) years using the modified ball canon.
- 3- To put percentiles for the tests measuring the ability of counter-attack in table tennis juniors less than (18) years using the modified ball canon.

Terminology:

- 1- Counter-attack (procedural term): it is the ability to attack against the opponent's attack using the same or any other type of spin with one or both faces of the racquet on the table to win a point.
- 2- Table Tennis Robot: it is a device that enables the player to play without a mate, and with its built-in computer unit it gives the opportunity to train on different speeds,

altitudes, spins and directions. This gives the player controlled game-like situations with the ability to remote control the game during performance.(19)

Methodology:

Approach:

The researcher used the descriptive (survey) approach.

Sample and Community:

The research community includes all junior table tennis players less than (18) years registered in the Egyptian Table Tennis Association during the training season 2009-2010 (127 players).sample was chosen from the players involved in the Open Egyptian National Championship (Mansoura – Egypt) from 22 to 26 August 2009. Sample was chosen purposefully as follows:

- Sample of pilot study (15 players) from the main community and outside the main sample.
- Main sample (112 players).
- The researcher homogenized the sample for growth factors (age, height and weight) and the training period as shown in table (1).

Table (1)
Sample homogeneity for the research variable (n=112)

S	Variables		Measurement	Means	SD	Median	Squewness
1-	Growth factors	Age	Year	17.0375	0.5549	16.80	0.180
		Height	Cm	174.312	1.857	174	-0.169
		Weight	Kg	66.607	1.7104	66	0.336
2-	Training period		Year	6.1045	0.3660	5.9	0.872

From table (1), it is clear that squewness values ranged from (0.872) to (-0.169) (between $3\pm$). This indicates that they are in the moderate curve, indicating the homogeneity of the sample for all variables.

Planning the research experiment:

Main sample was divided into two groups (56 players each). The first group was divided into two sub-groups (28 players each). This division led to three groups:

- Group (1) (n=28) to establish the suitability of the recommended tests (easiness and difficulty).
- Group (2) (n=28) to calculate the stability coefficients of the recommended tests.

- Group (3) (n=56) to calculate validity coefficients of the recommended tests.

The researcher used the whole sample (n=112) to calculate tables of percentiles for the recommended specific tests of counter-attack skill in junior table tennis players less than (18) years using the Table Tennis Robot. To insure the equivalence of all groups on the study variables the researcher re-calculated these variables for each group as shown in table (2).

Table (2)
Sample equivalence for comparing the three groups on all basic variables

S	Variables		Measurement	Groups	Means	SD	Median	Squewness
1-	Growth factors	Age	Year	N1 = 28	17.0214	0.5640	16.800	0.229
				N2 = 28	17.0536	0.5494	16.950	0.129
				N3 = 56	17.0375	0.5630	16.800	0.192
		Height	Cm	N1 = 28	174.464	1.0305	175	0.210
				N2 = 28	174.071	1.4123	174	-0.390
				N3 = 56	174.357	1.1350	174.01	0.097
		Weight	Kg	N1 = 28	66.7143	1.7397	66	0.339
				N2 = 28	66.142	1.7995	65.500	0.674
				N3 = 56	66.785	1.6372	66	0.255
2-	Training period		Year	N1 = 28	6.092	0.3731	5.900	0.904
				N2 = 28	6.1179	0.3560	6	0.425
				N3 = 56	6.1036	0.33737	5.900	0.886

From table (2), it is clear that means are greater than standard deviations and squewness values ranged from (0.904) to (-0.390), indicating that the three groups are homogenized and free from non-moderate distributions.

To insure that there are no differences between the three groups in the study variables, the researcher performed "One Way ANOVA" as shown in table (3)

Table (3)
One Way ANOVA for comparing the three groups on all basic variables

S	Variables	Measurement	Variance source	Squares sum	Freedom degrees	Squares means	F Values	
1-	Growth factors	Age	Year	Inter-group	0.01446	2	0.00723	0.023
				Intra-groups	34.168	109	0.313	
				Total	34.183	111		
		Height	Cm	Inter-group	2.384	2	1.192	0.845
				Intra-groups	153.679	109	1.410	
				Total	156.062	111		
		Weight	Kg	Inter-group	8.143	2	4.071	1.402
				Intra-groups	3165.57	109	2.904	
				Total	324.714	111		
2-	Training period	Year	Inter-group	0.00883	2	0.00441	0.032	
			Intra-groups	14.859	109	0.136		
			Total	14.868	111			

F values on $p \leq 0.05 = 3.55$

From table (3), it is clear that there are no statistically significant differences among the three groups on the basic study variables. This means that the existing differences are not significant and the three groups are equivalent.

Procedures of designing tests:

a) Designing tests:

The researcher designed (8) tests for the counter-attack skill in junior table tennis players using the Table Tennis Robot and he considered the following:

- To give the player the opportunity to perform with one or both faces of the racquet (for hand / back hand).
- The tests should measure different counter-attack skills.

- The tests should cover different spots on the table and the player should shoot the balls for all these spots.
- Tests should be game-like situations and movements should be logical and similar to real game situations. Also, the player should be familiar with movements and spin should be increased during the same test.
- Tests should clearly show the player's ability to perform counter-attack.
- Tests should be exciting and motivating for players. To do so, tests of attack alone were identified through literature review.
- All tests are designed for right-handed players and if the player is left-handed, the

ball path should be modified and control panel settings should be described.

The preliminary draft of the tests was prepared and taken to experts to give their opinions through the specified form. Experts were (8) professional of the field of table tennis (4 specialized physical education professors and 4 experienced coaches) (appendix 1). Experts gave their opinions and recommendations on the specified form (appendix 2).

b) Identifying and selecting tests:

The researcher used the following studies in designing tests: Ertna Patir (2008), Richard MacAfee (2008), Admin Tags (2009), Jili Song et al (2009), Martin Hors (2009), Tamasu Butterfly (2009), USATTF (2009) and Yasser Kamal & Ahmed Sobhy (2009) (7 – 16 – 2 – 12 – 15 – 19 – 22 – 25)

Tests are similar to match situations and are all in game-like form regarding speeds, altitudes, spins and directions. These variables cover all game situations. According to experts' opinions, balls' distances, speeds, spins and hit points with table were modified and tests reached its final form (appendix 3).

c) Trying out tests in its final form:

The researcher tried out the tests in its final form to identify:

- 1- Tests after experts modifications.
- 2- Time used in performing tests.
- 3- The suitable daily number of tested players.

Administrative and organizational aspects:

- 1- The researcher interviewed the team coaches to get their consent on performing tests.

- 2- The researcher prepared an individual form to record each player's data.
- 3- The researcher prepared the needed equipments:

- (100) table tennis balls (ITTF approved).
- Table (ITTF approved).
- Net (ITTF approved).
- Table tennis racquet and every player should attend tests with his/her own racquet.
- "Butterfly" ball canon (Amicus 300 Plus)

Pilot study:

The researcher performed the pilot study on a randomly chosen sample (15 players) from the research community and outside the main sample to make sure that speeds, spins and ball flight distances are suitable.

The researcher developed the tests in its final form and identified each test's time and total time for all tests. He also designed a form for evaluating the counter-attack skills where each player's data are recorded (appendix 5).

Standard procedures for the Table Tennis Robot functioning and assessment procedures:

1. The device is set in the middle of the table in front of the player and 30cm away from the table.
2. The player stands 30cm away from the table in front of the device and on the opposite side, holding his/her racquet and ready for performance.
3. The device is set separately for each test according to the following tables:

Test (1): For hand counter-attack against top-spin loops:

	Ball A	Ball B	Ball C	Ball DA
Ball	1	2	3	4
Speed	4	14	15	16
Spin	-2	5	6	6
Long/short	2	6	6	6
Left/right	1.5 left	1.5 left	1.7 left	2 left
Ball/minute	50/minute			
Type and location	Programmed			
cycle	120 seconds play			

Test (2): For hand counter-attack against side-spin loops:

	Ball A	Ball B	Ball C	Ball DA
Ball	1	2	3	4
Speed	6	12	14	18
Spin	-1	7	9	9
Long/short	2	6	7	6
Left/right	1 left	1.3 left	1.5left	1.7 left
Ball/minute	50/minute			
Type and location	Programmed			
cycle	120 seconds play			

Test (3): Back hand counter-attack against top-spin loops:

	Ball A	Ball B	Ball C	Ball DA
Ball	1	2	3	4
Speed	5	13	17	15
Spin	-3	4	5	4
Long/short	2	5	5	5
Left/right	Zero	3 right	3.5 right	4 right
Ball/minute	50/minute			
Type and location	Programmed			
cycle	120 seconds play			

Test (4): Back hand counter-attack against side-spin loops:

	Ball A	Ball B	Ball C	Ball DA
Ball	1	2	3	4
Speed	3	6	11	9
Spin	-1.5	-1.5	-2	-2
Long/short	3	4	5	4
Left/right	2 right	2 right	4.5 left	5 right
Ball/minute	50/minute			
Type and location	Programmed			
cycle	120 seconds play			

Test (5): Smash counter-attack against Smash shots:

	Ball A	Ball B	Ball C	Ball DA
Ball	1	2	3	4
Speed	9	11	13	11
Spin	3	-1.5	3	4
Long/short	5.5	5.5	5.5	6
Left/right	2.5 left	2.5 right	2.5 left	2.5 right
Ball/minute	50/minute			
Type and location	Programmed			
cycle	120 seconds play			

Test (6): Smash counter-attack against loops:

	Ball A	Ball B	Ball C	Ball DA
Ball	1	2	3	4
Speed	14	14	15	15
Spin	-1 side	4 top	-3 side	9 top
Long/short	4.5	-4.5	4.5	4.5
Left/right	1.5 left	1.5 right	2.5 left	3.5 right
Ball/minute	50/minute			
Type and location	Programmed			
cycle	120 seconds play			

Test (7): Random counter-attack (any kind of shots) against any kinds of shots:

	Ball A	Ball B	Ball C	Ball DA
Ball	1	2	3	4
Speed	2.5	11	12	17
Spin	-1	2	-3	5
Long/short	2	4	4	6
Left/right	3 right	2.5 left	3.5 right	3 left
Ball/minute	50/minute			
Type and location	Programmed			
cycle	120 seconds play			

Test (8): Open (back hand/for hand) counter-attack against back hand/for hand top- and side-spin loops:

	Ball A	Ball B	Ball C	Ball DA
Ball	1	2	3	4
Speed	3	9	12	15
Spin	-3 top	-1.5 side	2 top	5 side
Long/short	2	5	4	6
Left/right	2 left	3.5 right	3.5 left	4 right
Ball/minute	50/minute			
Type and location	Programmed			
cycle	120 seconds play			

Recording:

- Coach records the number of balls hit by the player from different locations on the table and balls descending to the middle of the table in front of the player.
- Do not record the balls that get out of the table. (appendix 3)

Statistical treatments:

The researcher used the following statistics:

- Means. – Standard Deviation.
- Median. – Sqewness.

- Pearson's correlation coefficient. Alpha Cronpach (α)
- One Way ANOVA Percentiles.

Calibrating the recommended tests:

- 1- To insure the easiness/difficulty of the recommended tests, the researcher applied the tests from 4 to 7-7-2009 on the first group (n=28) to insure that tests are suitable for junior players and to identify any problems or difficulties that may happen during the main study. Table (4) showed theses results.

Table (4)

Means, Standard Deviation, Median and Sqewness of first calibration sample scores on recommended tests (n=28)

S	Tests	Means	SD	Median	Sqewness
1-	For hand counter-attack against top-spin loops	58.607	2.282	59	0.582
2-	For hand counter-attack against side-spin loops	54.714	2.820	55	-0.207
3-	Back hand counter-attack against for hand-spin loops	40.892	0.875	41	0.138
4-	Back hand counter-attack against side-spin loops	48.071	2.814	47.50	0.372
5-	Smash counter-attack against smash shots	52.142	1.0789	52	1.221
6-	Smash counter-attack against loops	39.785	1.2869	40	-1.815
7-	Random counter-attack (using any attack shots) against any kind of attack shots	53.785	0.686	54	0.302
8-	Open (for hand/back hand) counter-attack against for hand/back hand top-spin and side-spin loops	42.285	0.8100	42	0.312

Table (4) indicates that all means are higher than standard deviation for all tests. This is a clear indication that the performance of all tests is free from non-moderate distributions as sqewness values ranged from (1,221) to (-1.815).

2- Validity of tests:

b) Internal consistency of each test.

The researcher calculated the validity of the recommended tests from 11 to 14-7-2009 using the following methods:

a) Validity of differences between contrasted groups.

To identify the ability of tests to differentiate between high and low levels, tests were applied on the third group (n=56). Scores were sorted in a descending order for each test. Upper quartile and lower quartile (14 players for each quartile) were identified as follows:

Table (5)
Validity of differences for the recommended tests (n=56)

S	Tests	Upper quartile (n=14)		Lower quartile (n=14)		(t) value
		Means	SD	Means	SD	
1-	For hand counter-attack against top-spin loops	47.285	0.825	61.857	1.099	39.65*
2-	For hand counter-attack against side-spin loops	52.285	1.540	64.017	0.916	24.597*
3-	Back hand counter-attack against for hand-spin loops	35.214	0.6993	40.00	1.109	13.654*
4-	Back hand counter-attack against side-spin loops	41.714	0.2301	51.00	1.797	11.898*
5-	Smash counter-attack against smash shots	44.857	1.231	52.142	1.099	16.513*
6-	Smash counter-attack against loops	35.214	0.6993	39.785	1.311	11.509*
7-	Random counter-attack (using any attack shots) against any kind of attack shots	43.500	0.3391	53.69	0.699	11.115*
8-	Open (for hand/back hand) counter-attack against for hand/back hand top-spin and side-spin loops	30.928	0.8287	42.285	0.825	36.330*

(t) Table values on $p \leq 0.05 = 2.14$

Table (5) shows statistically significant differences ($p \leq 0.05$) between the upper group and the lower group on scores of the recommended tests. This indicates that these tests are valid and capable of differentiating between the two different groups of junior table tennis players.

3- Stability of tests:

b) (α) Cronbach coefficient.

The researcher identified the stability of the recommended tests from 28 to 31-7-2009 using the following:

a) Test/re-test procedures.

The second group (n=28) was tested using the recommended tests and then re-tested using the same tests after (10) days to calculate correlation coefficient (r) and (α) Cronbach coefficient as shown in table (6).

Table (5)
Stability of the recommended tests (n=56)

S	Tests	Tests		Re-test		(r)	(α)
		Means	SD	Means	SD		
1-	For hand counter-attack against top-spin loops	61.857	1.099	62.214	1.050	0.894*	0.944
2-	For hand counter-attack against side-spin loops	64.017	0.916	64.278	1.193	0.757*	0.854
3-	Back hand counter-attack against for hand-spin loops	40.00	1.109	40.464	1.046	0.895*	0.9444
4-	Back hand counter-attack against side-spin loops	51.00	1.797	51.071	2.164	0.909*	0.952
5-	Smash counter-attack against smash shots	52.142	1.099	52.500	0.940	0.669*	0.802
6-	Smash counter-attack against loops	39.785	1.3114	39.928	1.730	0.806*	0.892
7-	Random counter-attack (using any attack shots) against any kind of attack shots	53.785	0.6993	54.00	0.784	0.841*	0.913
8-	Open (for hand/back hand) counter-attack against for hand/back hand top-spin and side-spin loops	42.285	0.8254	42.571	0.755	0.828*	0.905

(r) Values on $p \leq 0.05 = 0.707$

From table (6), stability coefficients for the counter-attack skills tests were significant on $p \leq 0.05$ between test and re-test. When applying (α) Cronbach coefficient on the tests, as they are considered as units of the whole counter-attacks skills test, (α) value was 0.9974.

Deriving Standards:

After insuring the validity and stability of the recommended tests, they were applied to the whole research sample (n=112) from 22 to 26-8-2009 during the Open Egyptian National Championship (Mansoura – Egypt) to prepare

tables of standardized levels and percentiles of the sample row points. Percentiles are one of most popular methods of evaluation and data presentation as they are more significant and accurate in distribution and help classifying individuals into graded levels (11) as shown in the following tables.

Table (7)

Standardized levels of counter-attack tests for junior table tennis players using the Table Tennis Robot (n=112)

(1) For hand counter-attack against top-spin loops		(2) For hand counter-attack against side-spin loops		(3) Back hand counter-attack against for hand-spin loops		(4) Back hand counter-attack against side-spin loops	
Row points	Standardized points	Row points	Standardized points	Row points	Standardized points	Row points	Standardized points
30	1.010-	46	1.447-	26	1.724-	30	1.741-
38	1.277-	48	1.291-	29	1.340-	32	1.140-
41	1.044-	00	1.130-	31	1.109-	33	1.380-
40	0.734-	01	1.007-	32	1.076-	36	1.129-
48	0.002-	02	0.979-	34	0.888-	39	0.873-
49	0.279-	04	0.8228-	30	0.787-	40	0.788-
03	0.114-	00	0.7447-	36	0.794-	43	0.032-
00	0.0408	09	0.010-	37	0.709-	40	0.032-
07	0.1909	09	0.432-	39	0.410-	47	0.191-
09	0.3010	62	0.098-	40	0.322-	48	0.107-
61	0.0061	63	0.119-	44	0.489-	00	0.73
63	0.7612	67	0.192	40	0.141-	02	0.234
66	0.8939	69	0.348	46	0.234-	04	0.400
68	1.049	71	0.004	48	0.4209-	06	0.070
69	1.126	73	0.761	01	0.799	08	0.746
73	1.436	76	0.890	03	0.880	61	1.001
70	1.091	78	1.001	00	1.071	64	1.207
76	1.769	79	1.129	06	1.164	66	1.428
78	1.824	88	1.832	09	1.443	68	1.098
80	1.979	90	1.988	60	1.036	70	1.769

Table (7) (cont...)

(5) Smash counter-attack against smash shots		(6) Smash counter-attack against loops		(7) Random counter-attack (using any attack shots) against any kind of attack shots		(8) Open (for hand/back hand) counter-attack against for hand/back hand top-spin and side-spin loops	
Row points	Standardized points	Row points	Standardized points	Row points	Standardized points	Row points	Standardized points
30	1.741-	20	1.741-	37	1.031-	27	1.007-
37	1.472-	27	1.473-	39	1.309-	29	1.387-
39	1.284-	29	1.286-	40	1.273-	33	1.147-
41	1.190-	30	1.197-	42	1.1017-	37	0.907-
40	0.700-	31	1.108-	43	1.1010-	40	0.727-
48	0.383-	32	1.019-	44	0.929-	43	0.040-
01	0.216-	34	0.841-	46	0.7077-	40	0.420-

(5) Smash counter-attack against smash shots		(6) Smash counter-attack against loops		(7) Random counter-attack (using any attack shots) against any kind of attack shots		(8) Open (for hand/back hand) counter-attack against for hand/back hand top-spin and side-spin loops	
02	0.127-	36	0.7632-	47	0.771-	49	0.180-
03	0.0381-	38	0.480-	48	0.080-	04	0.1104
00	0.139	41	0.2184	03	0.100-	09	0.416
07	0.3180	43	0.0400	00	0.0161	62	0.069
09	0.496	40	0.137	07	0.188	60	0.776
61	0.774	47	0.310	09	0.360	68	0.907
63	0.802	49	0.493	62	0.718	70	1.077
66	1.119	01	0.771	63	0.704	72	1.197
68	1.297	03	0.849	60	0.870	74	1.317
69	1.386	06	1.116	68	1.133	77	1.497
70	1.470	08	1.293	70	1.300	80	1.778
71	1.603	60	1.471	71	1.391	81	1.738
72	1.603	62	1.649	72	1.477	80	1.979

Table (8)

Percentiles and its corresponding points of counter-attack tests for junior table tennis players using the Table Tennis Robot (n=112)

Percentiles	(1) For hand counter-attack against top-spin loops	(2) For hand counter-attack against side-spin loops	(3) Back hand counter-attack against for hand-spin loops	(4) Back hand counter-attack against side-spin loops
100	80	90	60	70
90	78	88	09	68
90	70	80	08	60
80	73	83	06	64
80	66	76	00	63
70	63	73	04	08
70	61	71	03	06
60	09	69	01	00
60	07	67	48	04
00	00	60	46	02
00	03	63	43	49
40	01	61	42	47
40	49	09	39	40
30	47	08	37	43
30	40	00	36	41
20	44	04	34	39
20	42	02	32	37

Percentiles	(1) For hand counter-attack against top-spin loops	(2) For hand counter-attack against side-spin loops	(3) Back hand counter-attack against for hand-spin loops	(4) Back hand counter-attack against side-spin loops
100	40	50	30	36
10	38	48	27	33
0	30	46	26	30

Table (8) (cont...)

Percentiles	(5) Smash counter-attack against smash shots	(6) Smash counter-attack against loops	(7) Random counter-attack (using any attack shots) against any kind of attack shots	(8) Open (for hand/back hand) counter-attack against for hand/back hand top-spin and side-spin loops
100	72	62	72	80
90	71	61	71	81
90	70	60	70	77
80	68	59	69	73
80	66	56	66	67
70	63	53	64	62
70	61	51	62	60
60	59	49	60	59
60	57	47	59	57
50	50	40	57	54
50	53	43	50	52
40	51	41	53	49
40	49	39	50	40
30	48	38	49	43
30	46	36	48	40
20	44	34	46	38
20	42	32	44	34
10	41	31	42	33
10	38	28	40	30
0	30	20	37	27

Through to percentiles, the player can be classified according to his/her row points to several levels from poor to excellent. The researcher thinks that these levels can be as follows:

- Very poor (less than 5% to 25%)
- Poor (36% to 45%)
- Fair (46% to 60%)
- Good (61% to 79%)
- Excellent (higher than 80% and above)

As the technical level of the counter-attack skill is identified, the researcher indicates the importance of standardized levels and percentiles in this age group to evaluate the counter-attack skill in junior table tennis players (less than 18 years).

Conclusions:

The researcher concluded the following:

- 1- A set of specific tests for counter-attack skills for junior table tennis players using the Table Tennis Robot were designed. These tests are stable and valid and can measure the specific skills.
- 2- The recommended tests shed light on strengths and weaknesses of junior players' ability to perform counter-attack from different angles and distances.
- 3- The specifications of the recommended tests (ball speed, spin and distance) can be used for measuring the counter-attack skill using the Table Tennis Robot.
- 4- The recommended tests help classifying players and developing their abilities according to modern developments in table tennis.
- 5- The researcher concluded the standardized levels of counter-attack skills tests for junior table tennis players less than 18 years.
- 6- The researcher concluded the percentiles of counter-attack skills tests for junior table tennis players less than 18 years.

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- 7- Levels of table tennis junior players were identified according to other junior players' performance on the same tests.

Recommendations:

The researcher recommends the following:

- 1- To use counter-attacks skills tests for junior table tennis players using Table Tennis Robot in the training and selection processes of junior table tennis players.
- 2- To use counter-attacks skills tests for junior table tennis players using Table Tennis Robot as a means that help evaluating table tennis players and training counter-attack.
- 3- To use the conclusions of this research as guidelines for preparing and designing training programs for table tennis junior players.
- 4- The concluded test results represent indicators of technical performance of the sample and it is necessary to use them in evaluating and monitoring performance curves through follow-up assessments on suitable time intervals.
- 5- Performing further studies for designing sets of specific tests for measuring the defense abilities of table tennis players using the modified using Table Tennis Robot.
- 6- Researchers should study other aspects of the modified Table Tennis Robot as it is related to technical and tactical preparations, the most important requirements needed to reach higher levels.

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