

**ABSTRACT OF THE DOCTORAL THESIS
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**THESIS SUBMITTED TO: NATIONAL UNIVERSITY OF PHYSICAL
EDUCATION AND SPORTS, Bucharest, Romania, 2019**

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**THESIS TITLE: METHODOLOGICAL AND BIO-
MECHANICAL STRATEGIES FOR INCREASING THE EFFICIENCY OF
THE ATTACK FINALIZED BY TOPSPIN-RETOSPIN IN JUNIOR
FEMALE PLAYERS IN TABLE TENNIS**

Key words: *strategies (in high performance activity), biomechanical, attack, topspin-retospin, junior female.*

The attack finalized by topspin and re-topspin constitutes from technical and tactical point of view the most prolific expression at the table in table tennis, the entire endeavor achieved during the ball exchanges by female players up to the usage of the above mentioned elements being undertaken in order to hit decisively or with the purpose of preparing for finalization by forehand or backhand topspin or re-topspin, aspects which are ever present in the performance and contemporary high performance sports. As coach of the woman's team of a Division A, Voința Galați, I was convinced that the technical and tactical level of expression in the attack by topspin and re-topspin of each female athlete represents one of the most important indications of the performance capacity at this sport's discipline, the consolidation of the two technical elements especially at junior age being a priority to me. Accordingly, we consider that the scientific research for the amelioration of the performance capacity in junior female players undertaken by us represents a step meant to achieve this desideratum which is beneficial to the junior female table tennis players.

This Ph.D. thesis is structured in three parts, and contains 19 chapters. *First part* is the theoretical substantiation of the thesis and includes subjects like: the history of

the table tennis, the biomechanics of the topspin and re-topspin, the game regulation, the technical and tactical area, specific motive capacities.

Part II is represented by the exploratory research, with the following objectives: checking the didactic projection of the training system for one month used for the improvement of the attack by topspin – re-topspin, the utility of full HD audio – video recording system, and the biomechanical analysis software - Dartfish 360s, together with the mathematical analysis program, IBM SPSS Version 23. We have performed a sociological investigation based on survey, where we have applied a set of 31 questions specific to table tennis discipline, focused on technical – tactical area, physical training and specific movement skills in order to identify training strategies for the optimization of the topspin and re-topspin attack in female junior players, which was completed by a number of 21 coaches involved in the preparation of performance and high performance athletes in this discipline. Also, knowledge on the subjects, on the opportunities to use the control samples on the technical and tactical assessment and the motive capacities were part of the tasks of this part of exploratory research, the objectives being the relations with the specialists in the area in order to obtain information meant to build strategies of improvement of the attack finalized by topspin and re-topspin and the adaptation of an instrument for data recording of Full HD audio – video type in order to make the attack more efficient, with a biomechanical analysis software.

Part III represents the improving experiment, our own contribution to the methodological and bio-mechanical strategies for increasing the efficiency of the attack finalized by topspin-re-topspin in junior female table tennis players.

Experimental Research Hypotheses:

1st Hypothesis

- By applying strategies from methodic and biomechanical point of view in order to make more efficient the attack by topspin – re-topspin at junior female II players, the efficiency of the attack in the table tennis game will increase.

2nd Hypothesis

- The usage of a software for biomechanical analysis and assessment of the execution speed for the attack finalized by topspin and re-topspin will help to understand the favoring and perturbing aspects for obtaining the points within the sets of a game.

3rd Hypothesis

- By comparing the biomechanical executions of the two attack procedures

within initial and final testing of the female players belonging to the same category, we will be able to assess the level reached by our subjects and contribute to the creation of an optimum model of execution and of a methodological strategy of making efficient the topspin and re-topspin at junior female II players.

4th Hypothesis

- The validity of the concept of our training program in the competitive macrocycle for optimizing the attack as a way of organizing the training structures specific to training's periodization, and of the means and methods used to optimize the biomechanics of the topspin and re-topspin execution will improve the performance of the subjects of the experiment.

The experimental research objectives, tasks and used tests are:

- ❖ Creating a technical and tactical training and physical training program to be put into practice within the experimental group in order to streamline the topspin-re-topspin attack phase.
- ❖ Its judicious application according to the elaborated didactic design
- ❖ Using a biomechanical analysis program for topspin and re-topspin
- ❖ Identify the best executions and create a model in this direction
- ❖ Interpretation of the initial and final data in order to assess the program's efficiency
- ❖ Involve as many subjects as possible in the testing and experimentation program
- ❖ Funding the actual research
- ❖ Two tests had been used for the assessment of the motive capacities of speed and coordination (*Toss Wall Test and Naveta*), while for the technical and tactical expression level (*Diagonal Forehand and Backhand Topspin-Retopspin, Butterfly and Multiball training*), all having the role of highlighting values and aspects of relational nature which will be capitalized for our endeavor of experimental – ameliorative type.

Research period, place, subjects and logistic:

The amelioration experimental research was performed on a group of 20 subjects (junior female II athletes) belonging to a number of 8 national clubs which was split into 2 samples, one experimental sample and the other control sample of 10 subjects each and which represented the object of the testing, the strategy for making efficient the attack from biomechanical, technical and tactical, and physical point of view being applied only in the case of the subjects from the experimental group.

The same measurements and functional tests were applied to both samples. The training and testing period was developed during the competitive season between August 2016 and May 2017.

Experimental research approach synthesis:

During the competition period between 2016 and 2017 when our research had been carried out, both the experimental and control group components had participated in the contests for cadets, the advancement on the leaderboard being of 11% following to the implementation of the methodological strategies for making more efficient the attack by topspin and re-topspin in the case of the athletes involved. Audio-video images were collected both from the training rooms and during the competitions.

The data recorded pursuant to the use of questionnaires and carrying out of tests were stored, analyzed and statistically processed by using Microsoft Office, Excel programs and IBM SPSS, version 23.

Conclusions

With the help of *Dartfish 360s* biometric analysis program, we calculated the angular value and execution speed indices, highlighting the aspects on the three stages of striking the ball for the technical and tactical elements subjected to efficiency, watching these landmarks together with the female athletes from the experimental group, representing a means of awareness on their own executions, thus favoring the process of improvement of the execution biomechanics, the comparisons with the indices and the way of execution of the other female juniors, but also of older athletes in the same age category that were recorded for analysis, and drew a model to be followed, using for it the best technical achievements with topspin and re-topspin as examples.

It was also possible to highlight objectively the favoring and disruptive aspects of performing the procedures, such as the angles between the arm and the forearm, the direction of movement of the forearm and of the active arm, on the three moments of execution.

Based on the correlations we have achieved, we have discussed with female athletes the importance of anthropometric indices such as body weight and diameters of thighs and arms in the attack when we hit the ball with topspin and re-topspin.

Through the control samples used and the statistical and mathematical analysis and

interpretation programs, we have identified aspects on the level of correlations between the coordination capacities and the speed of movement in relation to the technical elements specific to the phase of attack under our scientific research.

The values recorded at the final testing for all the procedures aimed at efficiency increase subject to our research demonstrate the increase of the level of attack following to the adoption of our design model of training, as well as the means and methods used.

By comparing the execution levels at the final test of the junior female II players involved in the program for making more efficient the attack finalized by topspin and re-topspin with those from the initial testing, we are convinced that by using the Dartfish 360s computerized video technique we can identify the level of strengthening of the execution of attack-specific procedures and their speed, thus creating a model to be followed for field researchers and coaches involved in performance and high performance.

The same speed of execution for topspin will exert a beneficial influence on the re-topspin both in the forehand and in the backhand strike, as well as the way of initiation and the way of attack (attack angles) of the ball to the topspin on both sides being correlated with the success of the re-topspin from forehand and backhand.

The physical, technical and tactical training on the direction of speed training, striking the ball in front of the “rising” trunk and shortening the moment of finalizing the process was the way to succeed in reaching the goal of our research, as well as paying attention to both the forehand and backhand executions, becoming aware of the beneficial influence they exert from each other as a result of the correlations highlighted by mathematical calculations.

As the execution model resulting following to the scientific research of ameliorative type which we had performed, we propose the following landmarks of biomechanical nature and in what concerns the execution speed.

In what concerns the Forehand Topspin:

- the initiation of the strike will be situated on an angular value achieved by the arm and forearm comprised between 139° - 140°
- proper strike at $< 120^{\circ}$
- finalization of the strike at $< 87^{\circ}$
- execution speed 0.32 seconds

In what concerns the Backhand Topspin:

- the initiation of the strike will be situated on an angular value achieved

- by the arm and forearm of 115°
- proper strike at $< 95^{\circ}$
- finalization of the strike at $< 122^{\circ}$
- execution speed 0.28 sec

For Forehand Re-topspin:

- the initiation of the strike will be situated on an angular value achieved by the arm and forearm of 132°
- proper strike at $< 106^{\circ}$ - 107°
- finalization of the strike at $< 75^{\circ}$
- execution speed 0.274 sec

Fore Backhand Re-topspin:

- the initiation of the strike will be situated on an angular value achieved by the arm and forearm of 79 - 80°
- proper strike at $< 85^{\circ}$
- finalization of the strike at $< 129^{\circ}$ - 130°
- execution speed 0.23 sec

The validity of the concept of our training program in the competitive macrocycle for the effectiveness of the attack is confirmed by that 11 percent that represents the increase in the ranking of the experiment group achieved by the latter, the training periodization, the means and methods used to optimize the biomechanics of the topspin and re-topspin execution, favoring the performance improvement of the subjects involved in the experiment.

Also, by evaluating the somatic dimensions and the level of technical and tactical expression of the female athletes, we obtained data with the purpose of drawing an overview of the level of motive skills, of the technical and tactical sphere in attack, and the ways to optimize the topspin and re-topspin attack, as well as the opportunity to use the means (Dartfish 360s for biomechanical analysis, computer compatible with the installation requirements of the aforementioned program, data storage format in order to be able to analyze them - MP4, etc.) and methods (video recording made from the lateral part of the female athletes versus the front part of the technical-tactical executions, anthropometric assessment module, etc.) in the undertaken scientific research. In this section, we identified the need for cardiac frequency assessment with an instrument of watch type (Garmin 350) and a synchronized HR monitoring belt, to the detriment of the system placed at forearm level (MB60), to obtain the right values of the cardiovascular system of the junior female athletes during the attack by topspin and re-topspin.

Recommendations

The importance of attack completed by topspin and re-topspin in achieving performance goals is a strategic goal that can be achieved by analyzing the biomechanics of execution, by highlighting the strengths and weaknesses of the female athletes, by visualizing the images of an audio-video nature followed by applying the means and methods for making more efficient the two elements representing the working directions for the successful accomplishment of the proposed goal. Thus, the usage of a *Dartfish 360s* computerized software is a recommendation we make to all specialists involved in performance sports in this age group for an objective evaluation of the execution speed and biomechanics of the active arm, implicitly of the progress in time on the two coordinates.

We recommend the daily use of the technical and tactical training of the themes for the consolidation of topspin and the re-topspin executed with forehand and backhand, diversity and complexity in their choice and conception, the execution being done both near the game table and at half-distance.

The assessment of the progress of expression in the technical and tactical sphere with topspin and re-topspin by tests such as those applied by our research team, such as *Diagonal Forehand Retopspin* and *Diagonal Backhand Retopspin*, *Butterfly* and *Multiball Topspin-Retopspin* training, as well as those belonging to the Toss Wall Test and Naveta's specific motive capabilities are the optimal tools for both coaches and female athletes. Also, in order to optimize the topspin, we recommend practicing the backspin ball technique within the *Multiball* training, to increase the execution speed of the re-topspin, executing the element near the table and increasing the complexity by combining both technical and tactical procedures with both forehand and backhand.

Optimization of the specific movement speed with added step, using the ratio 5-seconds action, 5-seconds pause, during 17 such rounds made in 4-6 series approaching the average number of points and sets in a game and the specific movement mode in speed regime, the purpose being both the specific physical training and the favoring of a proper positioning to perform the attack completed by topspin and re-topspin during a game. The channeling of special physical training for the entire osteo-musculo-articular chain in the speed-force direction, the detention of the execution arm is according to the questioned specialists favoring the improvement of the topspin and re-topspin attack.