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**OPTIMIZATION OF TENNIS GAME IN
JUNIORS U12-U14 BY DEVELOPING MOTOR
AND PSYCHOMOTOR ABILITIES**

**DOCTORAL THESIS
ABSTRACT**

Keywords: training, motor abilities, psychomotricity, optimization, testing, tennis.

The thesis is structured in 3 parts, contains 15 chapters and a volume of appendices, with a bibliography including 163 works written by Romanian and foreign authors.

INTRODUCTION

The development of tennis game in the last half-century, especially in the past three decades, has cultivated the need for being practiced by young people with a robust physical constitution, endowed with remarkable motor qualities, particularly speed (under all its forms of manifestation: reaction, movement, execution and acceleration speed), explosive strength/ power, endurance and coordination.

Evidence resulting from the process of selection, preparation, participation, recovery, together with the adjustment between athletic and school schedules, all this complemented by a long-term observation of the internal competitive life, the study of specialized literature, the thorough knowledge of national tennis, represent the set of research methods used to achieve this thesis.

The research project aimed to be an objective guide, revealing the way in which the preparation of Romanian tennis players should act and determine the rigorous control of their selection, training and consecration in the next decade of the 21st century.

PART I – INFORMATION ON CURRENT TENNIS

Nowadays, more than ever, the preparation and management of training for tennis players rely on the imperatives of scientific research, which is conducted by teams of specialists in all fields: biology, physiology, biochemistry, biomechanics, nutrition, pedagogy, psychology, as well as in other related fields, who, together with the elite of tennis experts, decide on what the athlete should undertake in both the training process and sports competitions.

Our investigations and interventions in the preparation and promotion of juniors U12-U14 from our country (according to the Romanian Tennis Federation rankings in 2014 and 2015) were the reasons for choosing the theme, which was based on introducing new means of specific physical training, performing assessments by tests, trials and scientific observations, which finally ended in drawing positive and beneficial conclusions for increasing performance at junior level.

The theoretical, practical and methodical concepts used enabled us to concretize a series of principles, rules and requirements concerning the conduct of the experiment.

In conclusion, we think that our research project, in its integrity, has matched the modern idea of practicing the current tennis game, where the permanent offensive for each game action within the relationship of adversity between players provided the opportunity to reassess regularly and carefully the training methodology in tennis, in each stage of preparation.

PART II. PRELIMINARY STUDY ON THE OPERATIONAL RESEARCH

To conduct the preliminary research, we have completed the following stages:

- Studying the specialized literature related to research aimed at optimizing the tennis game for juniors U12-U14;
- Identifying the organizational aspects necessary to develop the game of tennis;
- Between October 2014 and January 2015 - structuring and developing the preliminary research plan, defining the research design;
- February 2015 - studying the psychomotor tests and trials;
- From March to May 2015 - applying the assessment tests to the athletes selected from the Romanian Tennis Federation rankings on 02.04.2014;
- May 2015 - recording the results obtained by athletes in the psychomotricity tests;

- May 2015 - performing the analysis and mathematical and statistical interpretation of the obtained results;
- Creating a database with the performances achieved by juniors U12-U14 in the psychomotricity tests;
- To scientifically prove the necessity of preliminary research in connection with the final one, we presented data from specialized literature, with references in this respect. Preliminary research aimed to check the working techniques and record the responses to the questionnaires used, as well as the parameters of this research.
- To initiate the preliminary research, we needed data that could be exploited, and the conditions for conducting it were natural.

Premises of the approach

The game of tennis, as a dynamic sports discipline, contributes to the complex and multilateral development of the frail body of the child, with influences on the biological, psychological, social and communicational areas of the young practitioner. The dynamic and varied demands based on fundamental and special motor skills require practical exercise in order to form a general and also special motor background.

Research objectives

- Knowing the indices of psychomotor qualities corresponding to the age and level of preparation, both theoretically and practically;
- Highlighting the indices of psychomotor qualities in order to optimize the game of juniors U12-U14;
- Improving coordination of specific tennis strokes in combination with other psychomotor qualities;
- Developing and maintaining the strength-speed ability at the level of segments and improving endurance through multiple repetitions of strokes in different phases of the game.

Research purpose

The research aimed to provide a broader dimension of the motor training component in juniors U12-U14, which included motricity-specific means (to find the best means for achieving the objectives) and implementation of test batteries to check mental and motor qualities.

Research tasks

- To collect and systematize theoretical information related to the research topic, provided by specialized literature through authors from our country and from abroad;
- To set the instructional objectives;
- To identify the assessment system for subjects;

- To make an ascertaining assessment of the level of biological, general and specific motor development of children practicing the tennis game;
- To check the efficiency of intervention means in improving psychomotor qualities of juniors U12-U14 included in the preliminary study.

Research hypotheses

The practical and methodical approach conducted by us aimed to demonstrate experimentally the following hypotheses:

- Using appropriate psychomotor stimuli in the preparation of juniors U12-U14 improves the manifestation level of psychomotor skills on which the intervention is done.

- If the preparation of juniors U12-U14 includes means specific to athletics, which are precisely targeted and directed, there will be obtained favorable effects on the development of psychomotor abilities.

Conducting the research

Application of the preliminary research program took place between 2014 and 2015. Throughout this period, the investigated subjects followed a purposely-designed physical and psychomotor preparation program. This original program was intended to contribute to improving the forms of preparation, learning and consolidation, so that the participants obtain positive results in the oncoming competitions. The working tools used were the following: tennis rackets, balls, a basket for balls, cones, ropes, elastics, dumbbells, a stopwatch, ladders and benches.

Subjects

Determining the volume of the sample investigated in our research was based on the national ranking; a number of 50 athletes were selected and subject to physical and psychomotor assessment tests and trials.

Location

Preliminary research was conducted at CNT Bucharest, at the sports clubs where our research subjects were registered, in the gym and on the Lia Manoliu National Stadium of Bucharest.

Period

The research was conducted over a 2-year period, namely between 2014 and 2015. Throughout the experiment, we collaborated with the junior players U12-U14, their coaches, parents and physical trainers, analyzing the evolution of athletes in the preparatory period and that of participation in competitions.

This communication activity with juniors U12-U14 relied on observation whenever it was possible (participation in the competitions

organized by the Romanian Tennis Federation, such as the National Championships for the age groups of 11-14 years - from 12 to 18 June 2014, the selection for the age groups of 11-12 years - from 10 to 14 October 2014, the Winter National Championships - from 12 to 18 January 2015, the training sessions conducted at the clubs where they were registered, during the experiment and the tests carried out).

It was thus created a prospective platform on the possibility of positively influencing the preparation of juniors U12-U14 included in the preliminary research.

Research methods and techniques used: bibliographic documentation method, conversation method, observation method, survey method, preliminary experiment method, test method, mathematical and statistical method, graphical method

PRELIMINARY RESEARCH FINDINGS

*Following the analysis and interpretation of data obtained during the preliminary research on juniors U12-U14, we can state that using appropriate psychomotor stimuli in the preparation of athletes improves the manifestation level of psychomotor abilities on which the intervention is done, which confirms **hypothesis no. 1.***

Data resulting from the preliminary research emphasized that the means used had a significant impact on performances in the following tests: Analogical Transfer Test, Spatial Orientation Test, Range of Motion Test and 5x18m Shuttle Run Test.

Data obtained from the statistical and mathematical processing of the performances obtained in the tests performed have revealed a higher psychomotor potential:

- **For the group of girls:** in the specific motor tests, the Labyrinth Test, average time is 13.99 seconds, and the average number of repetitions/minute in the Compass Test is equal to 42.4 repetitions. The average achieved in the Four-Jump Test is equal to 6.7 m;
- **For the group of boys:** in the specific motor tests, the Labyrinth Test, average time is 12.89 seconds, and the average number of repetitions/minute in the Compass Test is equal to 40.8. The average achieved in the Four-Jump Test is equal to 6.63 m.

*In the preparation of juniors U12-U14, using means specific to athletics, which are precisely targeted and directed, has led to favorable effects on the development of psychomotor abilities, which **confirms hypothesis no. 2.***

- At the anthropometric measurements, average height and weight for the group of girls is equal to 159.9 cm and 44.5 kg, respectively, and for the group of boys, average height is 158.1 cm, and average body weight is 43.6 kg.

Individual results had a non-homogeneous distribution, an aspect also emphasized by the values of the coefficient of variance, which indicates, for most trials, an average or low homogeneity of the subjects.

Comparing the results obtained by the investigated subjects, depending on their gender, has revealed that the development of psychomotor qualities in boys is superior to that of the girls.

ELEMENTS OF ORIGINALITY AND CAPITALIZATION OF PRELIMINARY RESULTS

A novelty element brought by the second part of our thesis is the testing of juniors U12-U14 using the following trials/tests:

- Range of Motion (for suppleness)
- Dynamic Flexibility
- 5x18m Shuttle Run
- Abdominal Exercise (lying back, raising the lower limbs at 90°)
- Standing Long Jump
- Rope Skipping
- Balance Keeping
- Pull-Ups
- 550m Run (minutes)

PART III. RESEARCH ON THE IMPROVEMENT OF TENNIS GAME IN JUNIORS U12-U14 BY DEVELOPING MOTOR AND PSYCHOMOTOR ABILITIES

The doctoral thesis aimed to highlight the existing correlation between physical, technical-tactical preparation and motor and psychomotor abilities, as well as the practical ways to improve these components of the game in juniors U12-U14.

The first two parts of the thesis, through the chapters included, ended the presentation of the main theoretical and methodical aspects reflected in specialty literature, and also the identification of the ways and means to develop motor and psychomotor abilities, personal contributions oriented towards the core results of the experiment and conclusions of the thesis, which might lead to the progress of tennis for juniors U12-U14.

Premises of experimental research

- We have started from the premise that psychomotricity has a particular influence on optimizing the tennis game of juniors U12-U14;
- The game of tennis contributes to the multilateral development of the body of the child, having important influences on the biological, psychological, social and communicational areas of the young performer;
- The specificity of tennis game, where the racket and ball are used, during the technical and tactical actions, increases and diversifies the child's psychomotor potential;
- Early participation in sports competitions specific to the age induces feelings of self-improvement and self-confidence, which strengthen the degree of socialization.

Objectives of experimental research

- improving the game of tennis in juniors U12-U14 by developing motor and psychomotor abilities;
- correlating the physical and technical-tactical preparation, as well as the practical ways to improve these components of the game at junior level;
- using the self-regulation techniques for the emotional, motivational and volitional states;
- developing the observation spirit, the quick analysis of situations and the selective and clear decision-making in some basic circumstances.

Purpose of experimental research

The research purpose was to provide a broader dimension of the motor and psychomotor preparation of juniors U12-U14 and also to find the efficient means to achieve our research goals.

Hypotheses of experimental research

- 1. Using the means of general physical preparation and those specific to tennis for improving/developing psychomotricity in juniors U12-U14 results in the improvement of their sports performances.*
- 2. Using purposely-planned and programmed exercises specific to athletics in the training lessons will lead to improving the physical preparation component, which induces positive manifestations of the subjects' attitude and behavior towards tennis, as a sports discipline.*

Methods used in the experimental research: directed observation method, psychosocial questionnaire survey method - for the athletes, recording method - "Presenting the chart of the game, set and match", experimental method, statistical and mathematical method, computerized graphical method

Theoretical and practical-methodical conclusions

- In juniors U12-U14, the processes of adaptation to physical and mental tasks follow the same rules as for adults.
- Due to the very quick development of the central nervous system during childhood, great importance should be given to the education of coordination abilities.
- Movement stimuli represent a physiological need for the optimal mental and physical development of juniors U12-U14.
- In children, the ways of exercising and the ability to provide effort should not be regarded as an optimal quantitative reduction of the adult ability. Each stage has its proportions, specific didactic tasks and its own development particularities.
- It should be noted that (technical) coordination and physical preparation must be developed in parallel, and that one could be predominant over the other, depending on the training goals.
- Assessing the motor learning ability is psychologically dependent on the psychomotricity area and is achieved by means of some trials and tests, such as: Analogical Transfer Test, Spatial Orientation Test, Distance and Speed Estimation Test, Intersegmental Coordination Test, Balance Test, Reaction Time, Discrimination and Vigilance Test.
- Psychological examination is recommended to be performed after the motor ability testing and to include tests for psychomotricity, attention, emotional stability, intelligence, personality structure and sociability.
- The average number of strokes in mesocycles (MSC) no. 1 and 3 was lower than in MSC no. 2, namely 4816 and 4900, respectively, compared to 8824, because more emphasis was placed on the point game in MSC no. 1 and 3.

Conclusions of experimental research

After analyzing the statistical processing of data, we highlight the following issues, which order and conclude aspects related to the biological, psychomotor and behavioral-attitudinal evolution of the experimental subjects, namely juniors U12-U14 practicing the game of tennis:

- **The values of growth and development indicators** for the children practicing tennis, within the studied time period, had a normal evolution, their height increasing by 3-5 cm on average (compared to the annual growth rate of 4-6 cm) and their weight increasing by 2-4 kg on average (compared to the annual growth rate of 3-6 kg).
- Differences in growth were significant, when comparing the two testing moments, the initial and final ones.

Hypothesis no. 1, which states that *using the means of general physical preparation and those specific to tennis for improving/developing psychomotricity in juniors U12-U14 results in the improvement of their sports performances*, **has been confirmed** by the intervention of operational systems specific to general physical preparation and to the game of tennis: this has significantly improved movement, execution and repetition speed of the investigated tennis players and has induced significant positive effects in the development of strength combined with speed and endurance (examples: at the following trials: 30m, 2x10m, 1000 m; from the questionnaires applied to the two categories of subjects, at items no. 10-a=85%, 12-c=72%, 13-c=72% and 14-c=100%; from the results achieved at the Winter National Championships by the experiment group players - charts of the game, set and match).

- Regarding the **evolution of behaviors and attitudes** towards sports activity in general and particularly towards the physical preparation of players U12-U14, they are aware and attached to the sports activities performed and are willing to collaborate and cooperate for their progress towards high performance.

- Regarding the **evolution of motor qualities/skills** of juniors U12-U14 within the studied interval, we highlight the following:

- **speed**, through its basic forms of manifestation, has positively developed, arguing the compared results, which indicate significant differences in the travelling speed (30m Run Test, 2x10m Shuttle Run Test), execution speed (Shuttle Run with 5 balls, a specific test) and repetition speed (the Fan and the Hexagon, two specific tests).

- **strength** has positively developed in this experimental period, arguing the compared results, which indicate significant differences in the wrist flexion strength (Wrist Flexion Test) and the explosive strength of lower limbs (Four-Jump Test, the Hexagon).

- **endurance** has improved as a result of directed intervention, the argument being the compared results, which indicate significant differences in the general endurance (1000m Run Test) and endurance combined with spatial orientation (the Fan Test).

- **coordination** has positively developed by its manifestation in some components, which is argued by comparing the results for: coordination combined with speed (Shuttle Run Test with 5 balls, the Fan - a specific test to assess travelling speed on the field); spatial orientation combined with speed (the Fan test); for some trials, although the coordination ability has improved, the compared results do not indicate significant differences between tests.

Hypothesis no. 2, according to which *using purposely-planned and programmed exercises specific to athletics in the training lessons will lead to improving the physical preparation component, which induces positive manifestations of the subjects' attitude and behavior towards tennis, as a sports*

discipline, has been confirmed, resulting in a significant improvement of athletes' motor and coordination abilities expressed by rapidity, specific spatial orientation, ability to combine movements, accuracy, increased speed, endurance and strength. The average coefficient of estimating speeds and distances for the experiment group is higher by 87.36 ms than for the control group, averages being 435.67 ms for the experiment group and 348.31 ms for the control group. The coefficient of estimating speeds and distances varies between 328 and 553 ms for the experiment group and between 96 and 514 ms for the control group. In both tests, data dispersion around the mean is relatively homogeneous.

- Coordination, in terms of accuracy under speed conditions (Shuttle Run Test with 5 balls), does not suggest significant differences between tests. The amount of mistakes for this trial (sending the ball to precise areas) was lower in the final testing, but not significantly. This can be explained by the fact that executions associating technical elements under speed conditions are not improved yet, which is related to the technical and tactical preparation.

By applying the preparation programs based on 3 mesocycles, juniors U12-U14 have recorded significant improvements for:

- Speed development, using: 10-30m sprints, handicap races, running between markers combined with jumps, combined with strokes, relay races;
- Strength development, using: exercises for the upper and lower limbs, torso, back, push-ups, triceps, elastic band kicks, jumping on objects;
- Endurance development, using: 1000m runs, at uniform, various and interval tempos;
- Coordination abilities, using: dumbbell strokes from standing/while moving, relay races between markers, etc.

We mention that, among the 50 subjects of our experimental research, some of them have maintained, in the competitive year 2015-2016, their very good results and position in the national ranking, winning competitions organized by the Romanian Tennis Federation, such as the Summer and Winter Championships, the Spring and Autumn selections, and represented Romania at the International Team Championships for the age groups of 12 and 14 years.

Elements of novelty/originality

Methodological contributions to the development of a system of means for improving general and specific psychomotricity in tennis represent a stage in increasing the preparation level of juniors U12-U14, being a crucial step in strengthening and enhancing these means to reach top performance. It can be noted the emergence of scientific and methodical thinking towards a real and

effective actuation of performances from the psychomotor, somatic, technical and tactical points of view.

Methodological contributions derive from the way of approaching the process meant to improve psychomotricity through means specific to athletics and tennis, of achieving preparation and finally of expressing it in competitions at the level of juniors U12-U14.

The psychomotricity development at the age of 11-14 years has and will have a major impact on the game playing of the future tennis player. The way of moving across the court, hitting the ball - technically speaking - and thinking each moment of the game will lead the player to become a winner or not.

Besides the elements of originality from the preliminary research, in the experimental research, through its component parts, we highlight the following aspects:

A - the theoretical foundation of the thesis provides for the tennis professionals and coaches some consistent benchmarks that refer to the bibliographic sources specific to tennis;

B - in the introductory part, there are emphasized terminological notions currently used by tennis coaches when working with children aged 8-10 and 11-14 years;

C - it has been made a parallel between the experiment and control groups in order to meet the purpose of this thesis;

D - there have been revealed some motor and psychomotor particularities of junior tennis players U12-U14;

E - it has been achieved a database relating to the psychomotor potential of young tennis players through the items of the test batteries applied;

F - it has been designed a differentiated program by value groups, according to the psychomotor potential of the research subjects;

G - it has been achieved a database including the results obtained by the research subjects in the trials and tests applied.

From our point of view, in terms of motricity and achieving the technical elements, the **novelties** we bring to the tennis game are the following:

1. *To hit the ball* coming to the player's court, they "*need to position*" not "to place" themselves, a term used and encountered in the language of most coaches. And this because the verb "to position" means having a favorable and also a correct position to hit the ball; for instance, to perform a forehand, the left leg and shoulder will be oriented towards the ball to hit it, the left leg will be oriented towards the place the ball is coming from, the right hand and the racket will be withdrawn backwards at shoulder height, so that the tip of the racket can be seen from behind the player.

This "positioning" corresponds to part one (out of three) required by the action of hitting the ball. It is compulsory for all technical elements specific to the game of tennis: service, baseline shots, volley, smash, slice, etc.

In the game of tennis, there are three types of *grips* (holding the racket with palm and fingers): forehand, hammer and backhand (for those executing the backhand with one hand). Hammer or continental grip is used in the following seven situations: when performing the serve; when performing the smash; when performing the volley; when performing the half-volley; when performing the slice; when performing the lob; when performing the cut. The other two grips can also be used, but the chances of success are lower.

2. *Executing the slice, as a technical element*, is used in the following five situations:

a – when the ball coming from the player's court has a too high trajectory and cannot be hit any longer using other technical elements;

b – when the ball has a too low trajectory to the ground, and *ibidem* "a";

c – when the ball is very strongly hit by the opponent, for example: smash, service, a baseline shot, lifted volley and slice;

d – when the ball is sent to the player's court sideways too much to the right or the left side and cannot be played any longer using a lift shot;

e – when one of the players wants to change the spinning direction of the ball from a lift shot to a slice shot, a change that bothers the opponent, who has to perform another positioning and another technical element to hit the ball.

3. *Executing the service, as a technical element*, is performed in six ways, as follows:

a) In the preparatory part for hitting the ball, legs are positioned behind the baseline of the court. To perform the serve, the racket grip is on the right side, the ball is thrown overhead and hit without leg flexion. It is used by children under the age of 10;

b) *Ibidem* „a”, the back foot steps to the right without leg flexion. It is practiced by children aged 10-12 years;

c) *Ibidem* “a”, legs are apart, the back foot raises from the ground, the support leg bends, then jumping and hitting the ball. It is used by amateur tennis players;

d) *Ibidem* “a” using the hammer grip, legs are close together, then flexion, jumping and hitting the ball. It is performed by the French player Gael Monfils;

e) *Ibidem* “d”, legs are apart, the front foot is positioned at 45° to the baseline and does not go closer to the back one, then leg flexion, jumping and hitting the ball. It is used by N. Djokovic, R. Federer, M. Raonic, A. Agassi, P. Sampras, M. Hingis.

f) *Ibidem* “d”, legs are apart, the back foot goes closer to the front one, then flexion, jumping and hitting the ball, while the back leg performs a knee flexion by lifting the heels up. It is used by R. Nadal, D. Ferrer, T. Berdych, S. Williams, M. Sharapova, C. Woznicki, S. Halep, M. Niculescu, M. Buzărnescu, I. Begu, A. Radwanska, A. Mitu.

To strengthen and improve multilateral technical preparation and physical preparation, we applied the following mathematical formula for the total number of themes:

$$\mathbf{STE = NA \times C}$$

Where: STE: total number of themes (tasks) in the MSC.

NA: number of training sessions to be performed within a MSC.

C: multiplication coefficient of the number of training sessions by period, as follows:

After verifying the preparation plans of tennis coaches, we found the following values of multiplication coefficient “C”, specific to the tennis sports branch:

- C= 6-8 (competitive period)
- C= 5 (precompetitive period)
- C= 2-4 (preparatory period)

The psychosocial questionnaire for players represents an element of novelty in our thesis.