IOSUD – "DUNAREA DE JOS" UNIVERSITY OF GALATI
The School for Doctoral Studies in Socio-Humanities

DOCTORAL THESIS ABSTRACT

Methodology for ameliorating the postural plantar deficiencies to optimize the topspin attack in table tennis (juniors III)

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Series: SSEF Nr. 1.
GALAŢI
2021

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INTRODUCTION

Motto: „Individualizarea tratamentului are o deosebită importanță, deoarece, ca și în medicină, tratăm bolnavi și nu boli” (*Individualizing the treatment has a special importance because, as in medicine, we treat the patient, not the diseases*) according to Cordun, (1999, pag. 24).

The development of the two activities brought forward by our research is represented by kinesiotherapy and performance sports doubled by the membership of table tennis in the Olympic family, since 1988, which increases the need to render the specific sports activity, supported by the new elements in the field of kinesiotherapy that have synergistic action in optimizing and achieving performance goals. The intensity and volume necessary for sports performance that the human body requires is almost to the extreme and is an aspect that needs the intervention of specific means of kinesiotherapy in performance sports. This can make the difference on the podium in sports competitions.

In this context, a kinesiotherapist is currently a must-have for the sports training team, at the level of performance, but especially at the level of high performance, who ensures the continuity of the athletes involved in the program of profile clubs in table tennis, by ameliorating the postural deficiencies and musculoskeletal problems.

We consider that our scientific endeavor will constitute a progress factor both from a practical point of view, by implementing a methodology for postural plantar evaluation and amelioration, as well as from a theoretical point of view by helping the trainers and researchers in the field regarding the importance of kinesiotherapy in table tennis.

As a practitioner in kinesiotherapy, I was involved in actions to ameliorate many deficiencies of osteo-muscular-articular nature and since the beginning of the master's studies and volunteering activities within the Kinesiotherapy Centre at the Faculty of Physical Education and Sports of "Dunarea de Jos" University of Galati, I got more involved in preventing and ameliorating the postural deficiencies of junior athletes involved in performance sports from town.

The desire to pass the assimilated information and the passion for improving people's life quality by applying means specific to kinesiotherapy, have put me in the position to discover the universe of scientific research, performance sports, as well as the opportunity to train new kinesiotherapists. All these factors have gradually materialized in a significant motivation that determined me to pick this doctoral thesis, which, with love and interest, I covered it. I consider that picking this topic for the doctoral thesis has enriched my life and has transformed me from a practitioner into an applied theorist in scientific research. The actions specific to this scientific endeavor had put me in the position to meet specialists from the field of table tennis, from kinesiotherapy and scientific research, and the interaction with them has refined me for 3 years in a unique way, for which I am grateful.

After covering more papers and articles close to my interest, I have noticed the novelty and originality of the undertaken scientific activity through the concept on the basis of which I conducted the experiment, through the way the evaluation was done, through the age category that was approached, and then through the nature of the identified correlations. The obtained results validate the fact that the posture influences the quality level of technical nature from the attack phase through a combined action between individualized orthotic insoles and a set of action systems necessary to ameliorate the postural plantar deficiencies.

These represented the fruition of the work undertaken on all the approached sectors and an impulse to continue such scientific approaches in table tennis, but also in other sports.

The body posture, the foot plant architecture, and the attack represent, from my point of view, one of the base pillars in winning game points and implicitly in achieving the established performance objectives in the case of the junior athletes involved in the scientific research that I have developed.

Creating a methodology for evaluating and ameliorating the postural plantar deficiencies, as well as identifying the action through which a protocol meant to improve the posture of the attack quality of topspin for juniors in table tennis represented my own purpose and the general objectives of the thesis, have guided our actions necessary to achieve it. The thesis's objectives were to outline the correction means necessary to create a postural plantar amelioration protocol by using non-invasive evaluation devices, to use a computer program to study the biomechanics of the topspin attack, to collect somatic data on the level of development and progress of the juniors in the period between the initial and final test. Processing, interpreting, and analysis of the postural data and the way of contact with the support surface of the lower limbs in static and dynamic phase, in order to identify the amelioration level from an angular and plantar point of view reached by juniors III, as well as to identify postural plantar qualitative correlations.

The national collaborations that I had carried out were in cities and clubs that have a tradition in performance table tennis, represented by Slatina, Sfântul Gheorghe, Bucharest (Pantelimon), Pitești, Râmnicu Sărat, Buzău and Galați. The athletes that participated in this scientific research are those who occupy high positions on the podium, as well as those in areas close to it. Moreover, I have previously identified medical clinics that have high-performant equipment useful for scientific research, while for the international area I have participated at a scientific congress through the National University of Physical Education and Sports *(I.C.P.E.S.K 2020)* as well as in traditional journals *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, *Annals of "Dunarea de Jos" University of Galati,i* and the *Balneo and PRM Research Journal* journal.

PART I - BIBLIOGRAPHICAL INFORMATION ASPECTS NECESSARY FOR DOCUMENTARY RESEARCH ON THE SCIENTIFIC APPROACH

I consider the theoretical documentation to be the necessary support for carrying out the scientific research under current adequate conditions (using software accepted in the scientific area and specific tests) regarding kinesiotherapy and table tennis. These have orientated my own research through the multitude of informational-bibliographical references, together with the identification of similar directions that other researchers were captivated by the beneficial influence of kinesiotherapy in performance sports and have relied on.

CHAPTER 1.
OPERATIONAL FRAMEWORK OF THE THEORETICAL BASIS

1.1. Premise

After carrying out complex scientific documentation of the bibliographical-informative publications specific to postural plantar deficiencies found also in table tennis, we have the theoretical support necessary to carry out the subsequent scientific approach.

1.2. Purpose

Identifying, processing, and analysing information that favors the subsequent creation of a methodology for evaluating and postural plantar amelioration with influence on the juniors' topspin attack in table tennis.

1.3. Documentary hypothesis

By analysing and interpreting current information from the publication of established authors of the fields of interest, we will extract data necessary for the future development of a methodology for evaluating and ameliorating postural deficiencies in order to optimize the topspin attack in table tennis.

1.4. Objectives

- studies regarding the types of postural attitudes, plantar imbalances, and injuries specific to table tennis;
- delimitation of morphological characteristic features specific to juniors III in table tennis;
- knowledge of the technical-tactical content from the attack's point of view specific for this sport;
- highlighting the biomechanical aspects necessary to successfully execute the topspin attack.

1.5. Tasks

- locating the local and university libraries, virtual scientific and the libraries' databases in order to study a bigger volume of theoretical information necessary to achieve the proposed purpose regarding the theoretical documentation but also the final one of the thesis;
- purchasing the working tools (laptop, information storage support, printer, and stationery);
- developing and drafting Part 1 of the doctoral thesis.

1.6. Research methods:

We will list and explain the applied research methods for carrying out the theoretical substantiation:

- **bibliographic study**;
- **conversation;**
- **recording;**
- **hermeneutics;**
- **logic;**
- **pedagogical observation.**

CHAPTER 3.
TABLE TENNIS TECHNIQUE

3.1. Terminology

The game's technical procedures and tactical aspects have a clear and exact denomination and have a special significance in the training process. These terms facilitate a homogeneous understanding of the notions used in the organization and development of the game of tennis.

The established terms (Feflea, 2015; Angelescu, 1977) are:

- *Forehand*: strike made from the side of the hand holding the racket.
- *Backhand:* strike made on the opposite side of the hand holding the racket.

- *Backspin:* strike made with a top-down movement of the game arm, giving the ball a backward rotation in the opposite direction of the flight direction.
- *Topspin:* technical element whose execution is achieved by a quick movement of the arm from bottom to top based on the tangential strike of the ball which gives a strong forward effect.

3.2. Technical-tactical elements and procedures

The table tennis technique is composed of a wide range of elements and specific technical-tactical procedures that represent their own motor expression support, made in correlation with the game's regulations, issued by the specialized federation.

3.2.2. Technical-tactical procedures specific for the attack

Due to the fact that the scientific research that we undertake has as its subject the influence of the topspin attack in the postural area in juniors, we believe that it is necessary to highlight and describe the most important technical-tactical procedures from the attack. These motor actions from the technical-tactical baggage of table tennis are done in three stages: preparing the strike, the actual strike, and finalizing the strike (Apostu, 2016, pag. 12).

Topspin with forehand and backhand from the ball with effect and without effect represent the most popular and used technical-tactical procedures from current table tennis. The attack is mainly initiated by using this raised shot that gives the ball both speed and effect, creating difficulty for the opponent, thus favoring an increase in the chances of winning the point.

CHAPTER 5.
ASPECTS REGARDING BODY AND FOOT PLANT ATTITUDE – IMPORTANT FACTORS OF THE LIFE QUALITY OF PERFORMANCE ATHLETES

5.1. Body posture attitude

Within this thesis and according to the specialised literature, the notion of "normal posture" is defined as the body's capacity to efficiently and constantly adapt to all external environment's influences and strains, the most important being gravity (Pop & Mihalcea, 2018). According to Paušić & Pedišić, et. al., (2010) all the angular values between the anatomical references must be equal to 0°. Human bipedal posture and locomotion has led to certain musculoskeletal adaptations in the human body, the most important being in the spine and legs (Cosoroabă & Cirin, et. al., 2020).

For children, postural disorders are the most common abnormalities of the musculoskeletal system (Grygus & Nesterchuk, et. al., 2020) and are the result of defective motor actions of the musculoskeletal system (Živković, 2009; Bubanj & Živković, et. al., 2012).

As a result of the undertaken theoretical research, I have identified in a study by Maali & Lamis, et. al., (2020) about the early detection of postural disorders in children by using a modern device called "Sensor Medica" doubled by a software called "FreeStep", these being useful in data collection and which received the endorsement of the French Association of Posturology.

5.2. Lower limb plant architecture

In the last two decades, scientific research has been made with regards to the deficient postural attitudes which can appear due to architectural imbalances at the level of the foot's plant due to the uneven distribution of body weight exerted on the plantar surfaces

(Cordun, 2009, pag. 87). The same author states that the lower limb's plant represents the base for the entire body in the bipedal position, during walking, but also when running, this being one of the most important "receptors" of the postural system.

According to Mudalige & Jayasundere, et. al., (2016) the distribution of pressure in the sole of the lower limbs with the ground is called plantar pressure and this is the basis for supporting the entire body in the orthostatic position, during walking and running, this being one of the most important receptors of the postural system.

Disorders of the lower limbs influence the static, but also the dynamics of the overlying joints, knees, hips, and spine. They occur due to imbalances found in areas of maximum pressure (Cordun, 2009, pag. 191).

The evaluation of the foot's plant and the ankle's joint needs to be done in orthostasis. The evaluating activities must be done in natural positions without any obstruction in terms of measurement, according to Yamamoto, et. al., (2020). In order to detect these plantar imbalances, the baropodometry platform is a useful and non-invasive tool for evaluating the foot's function (Lanuza, et. al., 2020).

5.3. Life quality

By exemplifying some definitions of the term related to this subschapter, thus it takes the form of an individual response to the physical, social, and mental effects of disorders that affect individual satisfaction in certain living conditions (Kabataş, 2020).

In performance sports, it is represented primarily by the feeling of winning in terms of competition, ranking on the podium being equivalent in principle, but not in total, to the highest level of life quality. Being human beings, an optimum state of health will create feelings of strength, confidence, and desire for continuity, characteristics necessary to perpetuate a state of wellness for practitioners involved in performance and high performance sports.

The efficient execution on both sides of striking the topspin technical-tactical element will be a huge advantage for meeting the performance objectives, the biomechanics of the execution requires in addition to theoretical, practical knowledge and posture-podiatric health of the athlete, all these sum up will favor a high life quality of athletes. The complexity of the sports training factors, but also fulfilling the desideratum of increasing the life quality leads to the need to form a multidisciplinary team in which the kinesiotherapist with the trainers will support by periodic evaluation and then by ameliorating, for cases that require intervention, the activity characteristic of performance.

CHAPTER 6.
EVALUATION METHODS AND MEANS USED IN DETECTING POSTURAL AND PLANTAR DEFICIENCIES

In the specialised literature, the most frequent used methods and means for evaluating the body posture and the foot's plant architecture are represented by:

- *somatoscopic evaluation of* body *posture* (Melo & Silva, et. al., 2011)**;**
- *X-ray examination of the spine* (Vrtovec & Pernuš, et. al., 2009)**;**
- *metric band* (by Oliveira & Candottet, et. al., 2012)**;**
- *photograph* (Paušić & Pedišić, et. al., 2010; Thang, et. al., 2011; Ambegaonkar & Caswell, et. al., 2014; Schwertner, et. al., 2016; Penna & Russo, et. al., 2017);

- *evaluation of the foot's plant using the baropodometry platform* (Giacomozzi & Leardini, et. al., 2014; Neto & Grecco, et. al., 2015; Zenovia & Eugen, 2016; Pop & Mihancea, et. al., 2018; Nisand & Callens, et. al., 2020; Ma & Lin, et. al., 2020; Cosoroabă, et. al., 2020; Iordan, et. al., 2021)**;**
- *3D scanner* (Gorton & Young, et. al., 2012)**.**

CHAPTER 8.
CONCLUSIONS OF THE THEORETICAL FOUNDATION

The analysis of specialised scientifical-method literature has highlighted certain factors which can trigger postural deficiencies and plantar imbalances, but also the importance of ameliorating them for age category according to our interest.

Other conclusions which can be taken from the theoretical foundation specific for part 1 of the undertaken scientific research are:

- from the analysis of the specialised literature regarding kinesiotherapy and table tennis results that the problem of postural deficiencies and of plantar imbalance are current problems and enriching the actual information is favorable for optimizing the capacity of athletes who practice sports, but also for opening new scientific research directions;
- the multitude of postural deficiencies and of plantar imbalances identified in the performance activity, and not only, require involvement from kinesiotherapy specialists and also from sports trainers. Then the formed interdisciplinary team, through cooperation, will achieve the performance objectives, but also a better life quality of the athletes;
- moreover, an improper posture that generates a muscular imbalance negatively influences the efficiency of the training process by a poor execution of the technical elements, thus influencing the performance capacity level and the results of the competition results;
- for the early detection of postural deficiencies in children, a modern device named "Sensor Medica" was used, doubled with the "FreeStep" software useful in collecting data. This system has been endorsed by the French Association of Posturology, useful information in our scientific development for the evaluation within the pilot study from part II of the thesis with real chances of being implemented in experimental research;
- from the conducted theoretical foundation, we have obtained information that the baropodometry platform is an efficient and non-invasive tool for detecting plantar imbalance. It is necessary to correct the imbalances and instability that occurred at the level of the foot plant because this develops an inefficiency of muscles and joints which results in postural deformities and walking disabilities and can have a negative influence on athletic performance;
- we consider it appropriate to detect postural deficiencies and plantar imbalances in the age category of 10-12 years with the purpose to improve the body posture of athletes because this pubertal period is marked by changes at the morphological level;

PART II
EXPLORING AND CHOOSING THE METHODS AND WORKING INSTRUMENTS

NECESSARY FOR EVALUATING THE POSTURAL PLANTAR DEFICIENCIES IN JUNIOR III (PILOT STUDY)

In table tennis, I believe that the direction that I have chosen is appropriate in identifying and ameliorating postural deficiencies and plantar imbalances for the age category 10-12 years with the purpose of improving the quality level of the topspin attack and that of the athlete's life because in this pubertal period there are important changes at the body's morphological level (Ganzenhuber & Balint, et. al., 2013), which is why this concept could be more effective.

In order to make this preliminary research stage, I have implemented a social survey based on an opinion questionnaire, participated in the competition hall, and followed the two competitions related to the specialized Federation at the National Team and Individual Championship for juniors III and seniors, observing also the biomechanics of the topspin attack, and also the body posture of the athletes during the game of table tennis.

CHAPTER 9.
OPERATIONAL FRAMEWORK OF THE PRELIMINARY RESEARCH

9.1. The premise of the research

In order to redact the first and second part, I have carried out a study on the tools, bibliographic informational journals, the means related to kinesiotherapy and table tennis from where we can extract the best methodologies for evaluating and treating in order to accomplish this scientific research.

9.2. The purpose of the research

Obtaining a large volume of information related to the postural plantar deficiencies that occurred in juvenile table tennis, by involving a large number of field related specialists.

Exploring and choosing some working methods and means of anthropometric, postural plantar, technical-tactical and biomechanical nature that are useful for evaluating our scientific endeavor on junior athletes between the age of 10 – 12 years.

9.3. The objectives of the research

- highlighting the importance of the evaluation by using the *baropodometry platform* and the *FreeStep software* to detect the plantar imbalances and the postural deficiencies for this sport in order to implement a treatment protocol to ameliorate the postural and plantar deficiencies;
- obtaining information by discussing with field related specialists, based on which we will then develop an evaluation and amelioration strategy of postural deficiencies and plantar imbalances;
- exploring and choosing the working tools specific to this somatic research stage, this being represented by tests and means specific to anthropometry, control tests specific to topspin attack, to related biomechanics, to the postural plantar evaluation equipment, audio-video, to the software for interpreting the collected data, all these in order to subsequently select the working methods and tools in order to implement them in the actual research.

9.4. The hypotheses of the prelimary research

By applying an opinion questionnaire regarding the influence of the body posture upon the topspin attack on a large number of field related specialists, we can obtain a volume of information meant to highlight the necessity to create a methodology for evaluating and ameliorating at postural level.

By the evaluation made with the help of the *baropodometry* platform and the *FreeStep* system, we can highlight the postural deficiencies and plantar imbalances at juniors between the age of 10 – 12 years.

By exploring the working methods and instruments, we will be able to identify the most appropriate means of evaluation used in a methodology appropriate to performance sports, to support the future development of a postural amelioration protocol in youth table tennis.

9.5. The tasks of the preliminary research

- involving a large number of table tennis specialists in the social survey based on opinion questionnaire;
- identifying the sports clubs affiliated to the Romanian Table Tennis Federation involved in official competitions for the junior III category;
- exploring and choosing current computer technologies like the FreeStep software by Sensor Medica, the biomechanics analysis software Dartfish 360S, statistical-mathematics software IBM SPSS vers. 23, and Microsoft Excel;
- involving a number of 3 subjects.

9.6. The research methods

Within this preliminary research, we have used certain research methods and the way they were applied:

- **bibliographic study method;**
- **pedagogical observation method;**
- **conversation method***;*
- **method of registration based on an opinion questionnaire**;
- **computerized graphics method**;
- **audio-video recording method**;
- **logical method;**
- **statistical-mathematical method.**

CHAPTER 10.
THEORETICAL-METHODICAL ASPECTS REGARDING THE POSSIBILITY OF USING THE EXPERIENCE OF SPECIALITY IN KINESIOTHERAPY AND TABLE TENNIS

10.4. Control tests specific to the topspin attack

They had as common denominator the technical element called topspin. It is made of both ball with effect and ball without effect on the side of the dexterous arm (forehand) and the diametrically opposite (backhand), directed diagonally and in line:

1. *Topspin with diagonal forehand done from blocking* (Mocanu, 2019; Feflea, 2015; Doboși, 2009);
2. *Topspin with diagonal backhand done from blocking* (Mocanu, 2019; Feflea, 2015; Doboși, 2009);
3. *Diagonal butterfly done from blocking* (Mocanu, 2019; Doboși, 2009);
4. *Line butterfly done from blocking* (Mocanu, 2019; Doboși, 2009);
5. *Multiball training* (Mocanu, 2019; Apostu, 2016; Feflea, 2015; Doboși, 2009).

10.5. Specific working methods and tools

For developing this preliminary scientific research, we have used an evaluation structured on the following directions:

- *medical-sports history* performed in order to obtain data on hereditary-collateral antecedents, personal pathological antecedents, performance activity and present activity;
- *survey method based on opinion questionnaire* addressed to specialists and preliminary research subjects to determine body posture, its influence on the spine and the effectiveness of the topspin attack;
- *anthropometric evaluation* done by measuring and calculating indices that allow an objective evaluation of longitudinal dimensions, transverse dimensions, circular dimensions, somatic mass dimensions, as well as physiometric data;
- *evaluation of mobility and muscle-joint elasticity* at the level of the spine, performed by specific anthropometry tests;
- *the frontal and sagittal postural evaluation* was performed through photography using the webcam and the *FreeStep* software (*Sensor Medica*) data processing, as well as by somatoscopic assessment;
- *plantar evaluation* was applied through the *baropodometry platform FreeMed* (static and dynamic phase), and the data was processed using the FreeStep (SensorMedica) software;
- *qualitative-technical evaluation* of the attack with topspin forehand and backhand, performed by five control tests specific to table tennis, chosen by the research team (forehand and backhand diagonal topspin; diagonal and line butterfly; multiball with and without backspin type effect);
- *evaluation of the angles* between the impact arm and forearm and the necessary execution time of those 5 tests formed by the forehand and backhand procedures specific to the topspin attack with the support of the DartFish 360s biomechanical analysis software;
- *evaluation of the life quality* using the Nottingham Health Profile (NHP) standardized questionnaire.

Anthropometric development was applied in order to highlight the level of morphological development and possible musculoskeletal imbalances, thus leading to a better identification of them, using the following means:

- Tefal electronic scale, for measuring body mass (body weight);
- metric tape (centimeter) with a scale from 1 cm – 150 cm, in order to measure the muscular perimeters;
- anthropometric compass (pelvimeter) in order to measure body diameters;
- GIMA tachometer for measuring the waist (height);
- hydraulic dynamometer, type SH5001, in order to measure the force of the palm flexors.

For the qualitative evaluation of the technical-tactical nature of the topspin element, we have used:

- a set of 50 balls with the size of 40.25 mm. (approved by the I.T.T.F.);
- biomechanical analysis software DartFish 360S;
- *Panasonic FULL HD Wireless* audio video camera that we have used in the qualitative evaluation of the technical-tactical nature.

CHAPTER 11.
ORGANIZING AND DEVELOPING THE PRELIMINARY SCIENTIFIC RESEARCH

In this chapter, we will present the junior III table tennis athletes evaluated by the working methods and tools, which we later intend to implement the most effective in the research itself. With the help of these methods and tools, we gathered data regarding the postural and plantar deficiencies, the quality level of the topspin attack, as well as the biomechanics of the execution of the same element. Moreover, we interviewed trainers of this sport (junior III) with the purpose to obtain a volume of information on which we can identify the influence and importance of body posture for the topspin attack in this age category.

11.1. The methodology of the preliminary research

In order to monitor the progress of the preliminary research, we have ordered its stages according to table no. 6.

Table no. 1. – Stages and tasks of the preliminary research 2018-2020

Crt. no.	**Stages of scientific research**	**Period of scientific research**	**Tasks of the scientific research**
1.	Conceptual and methodological substantiation of the paper	1 October 2018 - present	- research of specialized national and international journals; - documentation and research of the specialised literature of one's own interest (anatomy, physiotherapy, and medicine books; table tennis and biomechanics books).
2.	Implementation of the social survey based on an opinion questionnaire addressed to specialists in this discipline	30 January - 02 February 2020 (Buzău) 28 February - 01 March 2020 (Bucharest)	- participation in official competitions from the R.T.T.F. related to our interest; - identifying an optimal methodology to create a postural evaluation and amelioration protocol after the assessment; - gathering a volume of information from field related specialists regarding the influence of the body posture on the topspin attack at junior III.
3.	Organizing and developing the preliminary scientific and exploration research	02 - 05 February 2020	- creating the operational framework for preliminary research; - exploring and choosing working methods and tools; - contacting the sports club in order to accept the scientific research team; - identifying the necessary number of subjects for this stage and establishing the evaluation period.
4.	Subjects and place for developing the scientific research	06 – 11 February 2020 (Galați)	- identifying the juniors between 10 – 12 years involved in performance table tennis; - locating the sports and medical centres useful for developing the scientific

			research;
5.	Applying working methods and tools in order to develop the evaluation methodology	12 – 20 February 2020 (Galați)	- medical - sports history; - means specific to anthropometric evaluation (scale, tape measure, etc.); - tests specific to muscle-joint mobility and elasticity; - tools specific for the postural plantar evaluation (baropodometry platform FreeMed, photo camera, and the FreeStep software); - evaluation by 5 qualitative tests of the technical-tactical nature specific to topspin attack; - DartFish 360S computerized biomechanical analysis software.
6.	Statistical processing of the obtained results	21 February – 21 March 2020	- using the statistical-mathematical analysis program type IBM SPSS vers. 23 and Microsoft Excel in order to process the data of the preliminary research results; - graphical representation of the results obtained with the help of specific programs.
7.	Participating in national and international scientific conferences	11-13 June (Bucharest) – 18-20 June 2020 (Galați)	- disseminating the results obtained from the research carried out in the progress report 2.
8.	Redacting the preliminary research	22 March – 20 May	- establishing the structure of the progress report 2 (chapters, subchapters, etc.); - redacting the scientific material R.P. 2.

11.2. Subjects, place, and the duration of exploring the working methods and tools

In this preliminary research, we have chosen ***3 subjects*** (table no. 7) from table tennis involved in performance sports, members of ***Clubului A.C.S. ACTIV of Galați***, with a good state of health at the moment of the evaluation with the following characteristics: 12 years old, female, waist between 168 and 171 cm, body weight between 48 and 79 kg, the size of the foot sole between 38.5 and 40 cm, as well as a sports experience of 3,2 years.

- the place where the preliminary scientific research for this study was done was within a sports club where it carries out its performance activity (previously mentioned) on street **Traian no. 399**, benefiting from the agreement and collaboration with the trainer and the specialist in this sport. The action was carried out ***between 12.02.2020*** *until* ***20.02.2020***.
- in the second part of the scientific research, we have evaluated from the postural plantar point of view the subjects involved in research using the Sensor Medica system at the integrative medicine clinic “Sănătate cu Ozon” in Galați, str. Domnească no. 118 in collaboration with the specialist doctor from this unit **on 20.02.2020**.

11.3.1. The content and results of the opinion questionnaire

The questionnaire had a set of 15 questions created to facilitate and guide us to a better knowledge of the aspects of scientific interest, which should contribute to the accomplishment of this approach. The items used (has a closed type character - 12 and open type - 3) are related to body posture problems, the attack's importance, and the necessary aspects to optimize the quality element of the topspin element specific for table tennis for juniors between the age of 10 – 12 years.

This was applied to a number of 27 specialists (Iordan & Mocanu, et. al., 2021) involved in sports performance for this discipline. They have completed these questionnaires in an A4 type printed format, which can be consulted in annex no. 20, while the applied model can be found within annex no. 1.

Table no. 2. - List of interviewed specialists and the sports clubs where they work

CRT. NR.	LAST AND FIRST NAME OF THE SPECIALISTS	SPORTS CLUB
1.	A. B.	C.S. STIROM BUCUREȘTI
2.	A. F.-K.	C.S. FITFEEL ODORHEIU-SECUIESC
3.	B. D.	C.S.M. BUZĂU
4.	B. A.	C.S. VIITORUL PANTELIMON
5.	B. L.	A.C.S.O.V. PANTELIMON
6.	B. A.	C.S. STIROM BUCUREȘTI
7.	C. M.	C.S.M. MOINEȘTI
8.	C. G.	C.S.M. IAȘI
9.	C. A.	S.C.M. DUNĂREA 2020 GIURGIU
10.	D. G. A.	L.P.S. BISTRIȚA
11.	G. I.	C.S.S. ODORHEIU SECUIESC
12.	H. N.	A.C.S. DÂMBOVIȚA
13.	I. D.	C.N. RÂMNICU SĂRAT VLĂHUȚĂ
14.	K.-G. B.	LTNM TG. SECUIESC
15.	K. B.	C.S.S. SFÂNTU GHEORGHE
16.	M. V.	C.S.M. VATRA DORNEI
17.	M. V.	C.S.M. BUZĂU
18.	M. M.	FORMER TRAINER OF A.C.S. VOINȚA GALAȚI TEAM
19.	O. I.	SPORTIVUL CLUBURILOR POST SV MÜHLHAUSEN & SCM. GLORIA BUZĂU
20.	P. A.	A.S.D. T.T. BIELLA
21.	P. M.	C.S.M. VICTORIA CAREI
22.	P. G.	LOT NAȚIONAL ȘI C.S. PRISTAVU CÂMPULUNG
23.	P. C.	F.C. ARGEȘ
24.	Ș. R.	C.S.M. BUZĂU
25.	S. C.	L.P.S. SLATINA

26.	S. I. I.	C.S.S. SLATINA
27.	V.S.	A.C.S. ACTIV GALAȚI

Out of the 27 interviewed specialists, 26 are trainers and one well-known active athlete.

Table no. 3. - Open question no. 9 from the opinion questionnaire and the related answers

TYPE OF QUESTION	On a scale from 1 – 10 (1 = not important at all and 10 = extremely important), how much do you consider that a poor posture of the athlete can negatively influence the biomechanics of the topspin execution?	
	ANSWERS	PERCENTAGE %
	7	7,41
	8	29,63
	9	33,33
	10	29,63

In the opinion of specialists, a postural deficiency of the athlete negatively influences the biomechanics of the topspin execution. 9 on a scale numbered from 1 – 10 which places it as very important in the efficiency of the attack.

Table no. 4. - Open question no. 10 from the opinion questionnaire and the related answers

TYPE OF QUESTION	Following the execution of a certain technical procedure specific to the attack, could there be pain in the spine?	
	ANSWERS	PERCENTAGE %
	No	29,63
	Yes, cervical	3,70
	Yes, lumbar/topspin	51,85
	Yes, lumbar/topspin forehand	3,70
	Yes, thorax /topspin	7,41
	Yes, thorax /smash	3,70

From the specialists' answers, over half (51,85%) have confirmed that pain occurs, mainly in the lumbar region due to the execution of this technical element which involves a rapid unilateral twisting of the trunk.

11.10. The biomechanics of the topspin attack execution

The biomechanics of the execution technique of the topspin with a forehand in the case of a right athlete is described and structured in 3 parts. (Mocanu, 2019; Apostu, 2016; Dobоși, 2009).

11.10.1. DartFish 360S computer program for biomechanical analysis of the topspin attack in junior III

For the angular evaluation (between the execution arm and forearm) for the 3 phases (commencing the strike, the actual strike, and the end of the movement) necessary to execute the topspin attack procedures, together with the corresponding time (hundredths of a second), we could efficiently perform the processing and interpreting of audio-video data using the computer software previously mentioned, data that we obtained in the preliminary research.

We will present the results of the computerized analysis of the forehand topspin ball without and with effect procedure done with the help of the DartFish 360S software for athlete B.A. All the values obtained for the 3 stages of the topspin attack and its corresponding execution time can be observed.

Figure no. 1. - The biomechanics of the execution of the topspin on 3 parts for subject B.A., made with the backhand

Figure no. 2. - The biomechanics of the execution of the topspin on 3 parts, made with the forehand

CHAPTER 12.
PILOT STUDY NECESSARY TO EVALUATE POSTURAL PLANTAR DEFICIENCIES TO OPTIMIZE THE TOPSPIN ATTACK

We have covered the following component stages of the postural deficiency evaluation methodology that we would like to explore in this phase of the scientific research.

12.1. Presenting the proposed evaluation model

For this preliminary research stage of exploring and choosing the working tools and methods, we have staged the following phases specific for our interest which has been materialised in:

- **Medical - sports history**
- **Anthropometric evaluation**
- **Tests specific to the mobility and muscle-joint elasticity of the spine**
- **Postural plantar evaluation (realised with the FreeMed baropodometry platform and with the FreeStep software by Sensor Medica)**
- ***The plantar evaluation*** (analysed in static and dynamic phase) has been done on three junior athletes with the baropodometry platform and the values obtained for each subject were compared with the reference values (standard), aspects presented in the tables below for each athlete.

Table no. 5. - Baropodometric evaluation of the B.A. athlete in static, reported to the reference values

Analyzed characteristic / Plantar parameters	**Lower limb**	**Subject's value**	**Reference values**	**Differences**
Total plantar surface (cm^2)	left	89	110	-21 cm^2
	right	87	110	-23 cm^2

Full load pressure (%)	left S/F	50	50	55 ± 3	45 ± 3	-5	+5
	right S/F	53	47	55 ± 3	45 ± 3	-2(✓)	+2(✓)
Foot axis °	left	4		9-15		-5	
	right	4		9-15		-5	
The shape of the plantar arch	left	cavus foot		normal foot			
	right	cavus foot		normal foot			

**Legend*: S = back, F= front, ✓ = indicates the standard.

- **The postural evaluation** performed with the help of images and the FreeStep software on the three athletes, performed in the orthostatic position, highlighting the following aspects presented in the table below.

Table no. 6. - The angular value of the postural deficiencies obtained by the measurements made in the frontal plan (rear and front view) with the FreeStep software for the 3 athletes

Analyzed feature / Anatomical reference	**Subject B.A.**	**Subject P.D.**	**Subject P.R.**
Shoulder tilt (v.p.)	2° Drt.^	4°Stg.^	1° Stg.^
Scapular tilt (v.p.)	2° Drt.^	3° Stg.^	2° Stg.^
P.S.I.S. tilt (v.p.)	6° Drt.^	4° Drt.^	2° Drt.^
Pelvic tilt (v.a.)	4° Stg.	6° Stg.	3° Stg.

** Legend:* ^ =up, Drt. = right, Stg. = left, P.S.I.S. = postero-superior iliac spine, v.p. = rear view, v.a. = front view.

We notice asymmetries in the shoulders and scapula, the pelvis is bent to the left, the left knee joint is rotated inwards and the left subtalar joint is pronated.

The upper left limb (active arm) is more developed, longer, it has more force being opposed to deformation (dextro-convex thoracic) and no work will be done to compensate for the development of the clumsy arm, as the differences in perimeters between the arm segments are not large.

In order to identify the vicious postural attitudes in the sagittal plan in the evaluated athletes, we made a comparison presented in table no. 9 of the values obtained in relation to the reference values.

Table no. 7. - Evaluation of the elasticity degree (Freestep) of the subjects in stati,c reported to the reference values

Analyzed feature / Anatomical reference	**Subject B.A.**	**Subject P.D.**	**Subject P.R.**	**Reference value**
Arch of the cervical area (mm.)	69	48	11	40-65 mm.
Arch of the lumbar area (mm.)	69	30	3	30-45 mm.

In the case of elasticity for subject P.D., a normal value for both regions can be observed. In the case of athlete B.A., there is a cervical and lumbar hyperlordosis, and in the subject P.R. there is a cervical and lumbar straightness.

a) **Qualitative evaluation of the technical–tactical nature of the topspin attack performed by control tests**

As a result of the qualitative technical-tactical evaluation for the topspin attack, performed on the 3 junior athletes, we present the values of the averages obtained in the samples used:

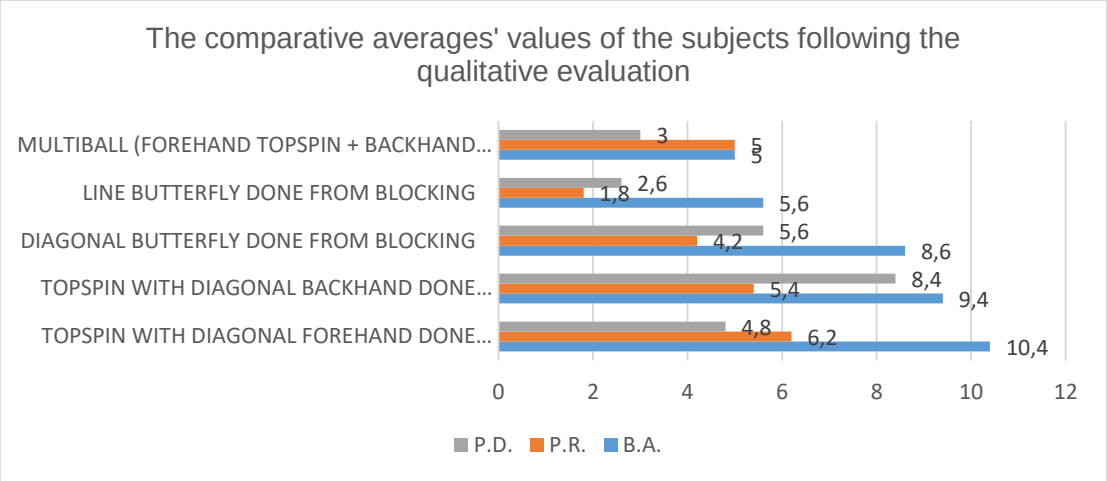

Chart no. 1. - The averages' values of the successes within the preliminary evaluation of the technical–tactical qualitative level for the topspin attack for the 3 athletes

Within the technical-tactical evaluation for the Multiball test, a lower value of success can be observed in the case of alternating effect for the topspin attack compared to the attempts in which the ball did not present such variations;

The arithmetic means *(for the 5 tests) in the case of the three athletes, the values achieved in the evaluation of the used technical–tactical are: B.A. – 39, P.D. – 24.4, P.R. – 22.6;*

b) **Evaluation of the *angles*' biomechanics of the active arm (arm-forearm) and the time necessary to perform the execution of the element called topspin**

Table no. 8. - The average values of the biomechanical indices for the diagonal forehand topspin from ball with backspin effect obtained from the evaluation of the three junior athletes

The component stages of the execution of the technical-tactical procedure / execution time	**Average angular values**
Topspin FOREHAND Commencing the strike <º	138,5
Topspin FOREHAND The actual strike <º	108,2
Topspin FOREHAND The end of the strike <º	75,9
Topspin FOREHAND Necessary execution time hundredths of sec.	**48**
Topspin BACKHAND Commencing the strike <º	114,5
Topspin BACKHAND The actual strike <º	91,5
Topspin BACKHAND The end of the strike <º	137,6
Topspin BACKHAND Necessary execution time hundredths of sec.	**38**

It is observed that the average time necessary to perform the technical procedure, *backhand* topspin, in the case of commencing the attack from the ball with *effect* requires a longer time by about *9 hundredths* of a second, compared to the situation of execution from the ball *without effect*. This analysis shows that counteracting and hitting the ball effectively requires large amplitude of twisting the trunk, which is why the striking time is longer.

12.2. Stages of implementing the program for ameliorating the postural plantar deficiencies

For the actual scientific research we intend to involve between 18 and 24 subjects, juniors between 10 and 12 years, members of the clubs sports team from Galaţi, Bucharest, Buzău, Râmnicu Sărat, Moineşti, Târgul Secuiesc, Giurgiu, Slatina, and Piteşti.

CHAPTER 13.
GENERAL CONCLUSIONS OF THE PRELIMINARY RESEARCH

13.1. Conclusions

In the preliminary scientific research, we have verified and confirmed the three working hyphotheses by the following aspects:

1. The social survey based on an opinion questionnaire, addressed to 27 table tennis specialists, resulted in the following conclusion meant to highlight the importance and necessity of the future development of a methodology for the postural evaluation and amelioration for this age category, as follows:

✓ the execution of the topspin is influenced by the entire osteo-muscular-articular system, the health of this system depends on the attack in which this technical-tactical element is used;

✓ the biomechanics of the topspin element execution is negatively influenced by the postural deficiencies;

✓ performing a preparatory part that takes into account the movements those that are not indicated for postural deficiencies in the spine that the athlete possesses;

✓ implementing the postural amelioration program after the preparatory part of the training according to the recommendations made by the interviewed specialists;

The influence of the topspin attack at the level of body posture resulted from the social survey based on questionnaire, favors the shaping of conclusions designed to optimize the performance of juniors to ameliorate postural problems that have a negative impact on the biomechanics in the execution of the most important technical element of the attack, and reduce lumbar pain, all helping to improve their life quality.

2. The evaluation performed with the help of the computer system for postural and plantar analysis, which highlighted the existing problems identified in performance table tennis at the evaluated juniors, between 10-12 years involved in this stage of the study, materialized through frontal and sagittal postural disorders, as well as plantar imbalances in the static and dynamic phase.

3. Applying and choosing the working methods and tools used in the preliminary research gave us a perspective regarding the creation of an evaluation methodology and highlighted useful aspects for increased efficiency in terms of time and working logistics.

For highlighting the 3 phases specific for the topspin attack in table tennis it is necessary to position the camera in front of the athlete, as well as at the back, at a distance between 0.5 m – 1 m.

➢ we recommend for the **multiball test**:

- ✓ positioning the audio-video camera for the **forehand** executions in front of the athlete during three series and at the back for the following two series (for a better capture of the arm and forearm angle when commencing the strike);
- ✓ then for the **backhand** strikes for this test, the camera will be placed only in front of the athlete, slightly to the side, positioning behind it prevents the perception of angles related to the stages of the strike;

We can conclude based on the values disseminated above that the execution of the topspin from balls with effect stresses the trunk more than from balls without effect for both procedures related to the topspin attack.

PART III
EXPERIMENTAL RESEARCH TO AMELIORATE THE POSTURAL PLANTAR DEFICIENCIES IN JUNIOR III IN TABLE TENNIS

Within the first two parts of the scientific research of the doctoral thesis presented during the studies within I.O.S.U.D. of D.J.U.G., we have established the importance of our scientific research direction through a theoretical foundation and then we verified the opportunity to use the working tools by applying and choosing the methods, means and the possibilities of carrying out, in good conditions during the pandemic of Covid-19, of the actual experimental research, materialised by kinesiotherapeutic amelioration research aimed at improving the performance capacity of the age category related to juniors III, by adopting a methodology for evaluating and ameliorating postural plantar deficiencies in table tennis.

CHAPTER 14.
OPERATIONAL FRAMEWORK OF THE EXPERIMENTAL RESEARCH

14.1. Premise

Knowing the influence of postural plantar deficiencies and the quality level of the topspin attack at this age, we will be able to implement an amelioration methodology based on a postural compensation protocol with the perspective of improving the body posture and optimizing the quality level of the topspin attack.

We answer the actual demands for the development of table tennis, by conducting a study on this new way to optimize the attack quality by ameliorating the postural deficiencies and plantar imbalances.

14.2. Purpose

Developing an ameliorating protocol that will improve the body posture and plantar balance with possible influences in qualitatively streamlining the topspin attack. This concept is materialised by reducing the angles which signify the existence of postural deficiencies of muscular-articular nature, as well as balancing the architecture of the sole of the foot by adopting means of correction for this age category.

14.3. The hypotheses of the experimental research

- ✓ By using a new methodology for evaluating and ameliorating based on a postural plantar compensation protocol, we will be able to appreciably improve the quality of the topspin attack in table tennis for junior III.
- ✓ It is assumed that by applying a postural plantar amelioration protocol, the life quality of the athletes will be influenced as well, during the performance activity and after finalizing it.

14.4. Objectives

✓ Outlining the main aspects necessary to create a protocol for postural and plantar amelioration for this age category in table tennis by using non-invasive evaluation devices.

✓ Using a computer program to study the topspin attack's biomechanics necessary for identifying the progress after the postural plantar amelioration protocol was applied.

✓ Gathering somatic data on the development and progress level of the juniors between the initial and final test.

✓ Processing, interpreting, and analyzing the postural data and the way of contact with the supporting surface of the foot in the static and dynamic phase, in order to identify the level of amelioration reached by juniors III.

✓ Identifying the somato-postural-qualitative correlations meant to enrich the practical-theoretical knowledge for this age category in table tennis.

✓ Measuring the level of improving the life quality by comparing the data resulted after the standard questionnaire within the social survey was applied, in which the subjects from this research were involved.

14.5. Tasks

✓ Its judicious application according to the specifics of the deficiencies and of the specific kinesiotherapy methodology in the preparatory part of the training achieving its implementation;

✓ Using an analysis program from the biomechanical point of view of topspin within the initial test and the final test.

✓ Involving a large number of junior athletes in the testing and experimental stages.

✓ Identifying the clinics that possess specific equipment and the FreeStep by SensorMedica software necessary for postural and plantar evaluation of the subjects.

✓ Identifying the necessary mean to produce individualized orthotic insoles after the initial evaluation.

✓ Funding of the research.

14.6. Research methods

In order to develop this doctoral thesis, we have applied a series of research methods and means meant to facilitate the achievement of our amelioration endeavor, which would favor the obtaining, processing, and interpreting of the data as a result of the methodology used.

Interdisciplinarity was a direction we pursued due to the current requirements for scientific research specific to kinesiotherapy in performance sports, which we consider to be in line with current requirements and trends.

We will enumerate and explain the way we applied the research methods for carrying out the actual experiment:

- **pedagogical observation method**;
- **conversation method**;
- **audio-video recording method**;
- **logical method**;
- **black-box method;**
- **the statistical-mathematic** method was meant to interpret the results obtained within the two tests, as well as correlating them regarding possible relations between the values resulted from the postural, plantar, anthropometric, technical-tactical, and biomechanic evaluations (SPSS vers. 23, Excel) materialized by the calculation of

statistical indices, Anova method, Pearson correlation coefficient, mean value, standard deviation, dispersion, standard error, and test z (t).

- **computerized graphics method.**

CHAPTER 15.
MANAGEMENT OF EXPERIMENTAL SCIENTIFIC RESEARCH

The consolidation of the collaboration relations with table tennis specialists and with those from the medical clinics was very important in order to be involved in the scientific research, informing them about the interest of our experiment and the actions we will take in the sports clubs that have agreed to conduct the experiment. The working manner and the testing periods were agreed upon with the trainers.

Table no. 9. - Stages and tasks of the actual research 2020 - 2021

Crt. no.	Research stages	Period	Tasks of the research activity
1.	Organizing and developing the experimental scientific research	21 May – 21 June 2020	- determining the type of research; - determining the operational framework of the actual research; - determining the evaluation means and methods; - identifying the sports clubs for accepting the research team; - determining the number of athletes; - determining the necessary time for the initial and final evaluation; - determining the time for developing the amelioration protocol; - determining the time in order to cover the protocol for postural amelioration of the athletes.
2.	Establishing the subjects and places for the scientific research	22 June – 17 August 2020	- identifying the sports clubs and the medical centers for carrying out the research; - contacting the sports clubs and medical clinics in order to accept the research team; - setting the criteria for including the subjects in the experiment group.
3.	Initial test	18 – 31 August 2020	- medical-sports history; - anthropometric evaluation and related tests; - postural plantar evaluation using the Sensor Medica system; - qualitative evaluation of the topspin attack, through 5 specific tests, in table tennis;

			- evaluating the angles between the arm-forearm on impact and the time required for the execution of the 5 samples using the computer biomechanical analysis software DartFish 360S; - evaluating the life quality with the NHP (*Nottingham* Health Profile) questionnaire; - processing and interpreting the data.
4.	Developing and implementing the amelioration protocol related to the deficiencies of planting positions	01 – 12 September 2020	- applying the inclusion criteria for the experiment group; - establishing the action system used in the recovery system; - producing the individualized orthotic insoles with the help of the VULCAN VX1 device by Sensor Medica; - covering the amelioration protocol by each subject of the experiment group (after the preparatory part); - wearing the orthotic insoles (it is mandatory to wear them during the entire training); - completing the daily activity sheet regarding the periodicity of trainings and performance of the protocol.
5.	Final test	01 - 07 February 2021	The final evaluation regarding: - medical-sports history; - anthropometric evaluation of the subjects; - anthropometrical tests regarding the juniors' articular mobility and muscular elasticity; - postural plantar evaluation; - technical–tactical qualitative evaluation of the attack through 5 specific tests in table tennis; - evaluation of the angles between the arm-forearm and the time necessary to perform each 5 tests using the computerized biomechanical analysis software DartFish 360S; - evaluation of the life quality with the NHP (*Nottingham* Health Profile) questionnaire; - processing and interpreting the data.
6.	Statistical processing of the obtained results	16 September 2020 –	- using the statistical-mathematic analysis program IBM SPSS vers. 23 for processing the resulted data from the

		07 March 2021	research done in the initial test and final test. - chart and table representation of the obtained results with the help of specific programs.
7.	Drafting the actual research	1 October 2020 – 25 March 2021	- establishing the 3rd part of the progress structure (chapters, subchapters, etc.); - redacting the scientific material dedicated to part 3.

15.1. Subjects

The experimental amelioration research was conducted on 18 subjects, female, divided into two groups with 9 subjects for the experiment group and the same number for the control group, from 7 sports clubs, between the age of 10 and 12 years (juniors III).

The testing and implementation of the postural plantar amelioration protocol were carried out in a special period of sports and competitive training generated by the SARS-COV 2 pandemic, the research being done starting with August 2020 (initial test) and finalized in February 2021 (final test).

15.2. Component subjects of the experiment group

The athletes from table no. 43 were part of the experiment group. They fitted in the inclusion criteria that we adopted, having the characteristics presented below.

Table no. 10. - Athletes of the experiment group

Crt. no.	Last and first name	Game profile	Active arm used	Diagnostic
1.	P.D.G.	OFFENSIVE	RIGHT	Scoliotic attitude in S (lumbar sinistroconvex and thoracic convex dextro), lumbar hyperlordosis, bilateral flat foot
2.	B.A.	OFFENSIVE	LEFT	Scoliotic attitude in S (lumbar sinistoconvex and thoracic dextro convex), lumbar and cervical hyperlordosis, bilateral cavus foot
3.	G.D.	OFFENSIVE	RIGHT	Scoliotic attitude in S (lumbar sinistoconvex and thoracic dextro convex), lumbar and cervical hyperlordosis, bilateral cavus foot
4.	B.D.	COMPLETE	RIGHT	Scoliotic attitude in S (lumbar sinistroconvex and right convex thoracic), lumbar hyperlordosis, bilateral hollow leg, lower limb inequality
5.	S.P.	OFFENSIVE	LEFT	Scoliotic attitude in S (lumbar sinistroconvex and right

				thoracic convex dextro), lumbar hyperlordosis, bilateral cavus foot
6.	V.I.	OFFENSIVE	RIGHT	Scoliotic attitude in C lumbar hyperlordosis, bilateral cavus foot
7.	A.S.	OFFENSIVE	RIGHT	Scoliotic attitude in S (lumbar dextroconvex and sinister thoracic convex), lumbar hyperlordosis, bilateral cavus foot
8.	F.B.	OFFENSIVE	RIGHT	Scoliotic attitude (lumbar convex dextro and thoracic convex sinister), lumbar hyperlordosis, mixed legs (left – cavus, right - normal), uneven lower limbs.
9.	M.A.M.	OFFENSIVE	RIGHT	Scoliotic attitude in S (lumbar dextroconvex and sinister thoracic convex) lumbar hyperlordosis, thoracic hyperkyphosis, bilateral cavus foot

15.3. Component subjects of the control group

Within this group (table no. 44), juniors who are members of four sports clubs agreed to collaborate with us and showed interest in the research direction. In the case of this group, the initial and final test was performed without applying the postular amelioration protocol, component of the methodology for the 9 athletes of the control lot.

Table no. 11. - Athletes of the control group

Crt. no.	Last and first name	Game profile	Active arm used	Diagnostic
1.	B.A.	OFFENSIVE	RIGHT	Bilateral valgus leg, pelvic and shoulder asymmetry.
2.	B.AN	OFFENSIVE	RIGHT	Bilateral valgus leg, inequality of the lower limbs
3.	B.I.	OFFENSIVE	RIGHT	Bilateral hallux valgus
4.	D.A.	OFFENSIVE	LEFT	Scoliotic attitude in S, lumbar hyperlordosis and right valgus leg
5.	F.C.	OFFENSIVE	RIGHT	Bilateral valgus leg, thoracic hyperkyphosis and lumbar hyperlordosis
6.	G.A.E.	OFFENSIVE	RIGHT	Scoliotic attitude in S

7.	G.P.	COMPLETE	RIGHT	Scoliotic attitude in C and overweight.
8.	I.T.	OFFENSIVE	RIGHT	Mixed leg (normal left and right cavus)
9.	V.S.E.	OFFENSIVE	RIGHT	Bilateral valgus knee; dorsal hyperkyphosis

15.4. Venue

The actual scientific research was carried out within seven national sports clubs that have athletes who meet the conditions for the junior III category and in the medical clinics with modern equipment necessary for the postural and plantar evaluation, these being:

- A.C.S.O.V. PANTELIMON - *Medical clinic Bucharest;*
- C.S.M. BUZĂU - *Medical clinic Galați;*
- C.N.A.V. RÂMNICU SĂRAT - *Medical clinic Galați;*
- L.P.S. SLATINA - *Medical clinic Pitești;*
- F.C. ARGEȘ - *Medical clinic Pitești*;
- C.S.S. SFÂNTUL GHEORGHE - *Medical clinic Brașov;*
- A.C.S. ACTIV GALAŢI - *Medical clinic Galați.*

15.5. Period

The actual research period started with the initial one, between 18 August – 1 September 2020, and ended with the final test that was carried out between 1 February – 7 February 2021.

The introduction of the amelioration protocol (composed of the kinesiotherapy specific action systems and the individualized orthotic insoles) for all the subjects from the experiment group was carried out for 4 days (9 – 12 September 2021).

We could not carry out the scientific research during the intern official calendar because the competitional season was disrupted by the prolonged Coronavirus pandemic which started in March 2020 and it was constantly disrupted by the evolution of this special situation in terms of human health.

15.5.1. The inclusion criteria in the experiment group

The inclusion in the experiment group of the junior III athletes who participated in the scientific study, was done after the following criteria:

- the highest angular values among the anatomical references, especially at the level of the pelvis (posterior-superior iliac spine) in the frontal plan;
- the most accentuated imbalances at the plantar level (from the static phase as well as from the dynamic one);
- the highest numerical values in terms of pain perception and life quality;
- parents' consent for implementing the amelioration protocol for the chosen subjects in the experimental research.

15.6. The logistics of the experimental approach

We will enumerate a part of the tools used in the actual research with the purpose of highlighting them:

- ✓ Video camera and the postural analysis software named FreeStept by Sensor Medica.
- ✓ FreeMed baropodometry platform and the previous mentioned software for the plantar evaluation.

- ✓ Biomechanical analysis software, type Dartfish 360S.
- ✓ Analysis program for the gathered data IBM SPSS Statistics, version 23.
- ✓ Design device (milling machine) for the individualized orthotic insoles, type Vulcan – Vx1.
- ✓ The audio-video recordings were taken with a Panasonic camera, with a built-in Full HD technology.
- ✓ A.C.S. ACTIV Galați gymnasium, located on street Traian no. 399.
- ✓ Table tennis hall, L.P.S. (high school with sports program), from Slatina on str. Toamnei no. 10.
- ✓ Physical Education and Sports hall, from Piteşti within the ‘’Matei Basarab’’ Secondary School no. 19.
- ✓ Table tennis hall, from Pantelimon, Ilfov county, str. Sfântul Gheorghe, no. 23.
- ✓ Topspin Table tennis hall, from Sfântul Gheorghe, str. Andrei Șaguna.

15.7. Evaluation methods and instruments used in the experimental research

After exploring and choosing the working methods and instruments necessary for the experimental research, we proposed and implemented the following evaluation directions:

- medical-sports history done with the help of the standard questionnaire;
- anthropometric evaluation by measuring the longitudinal dimensions, transverse dimensions, circular dimensions, somatic mass dimensions, and physiometric data;
- evaluation of muscle-joint mobility and elasticity in the spine using anthropometric tests;
- postural evaluation by photography and with the FreeStep By Sensor Medica software;
- plantar evaluation done with the help of the *FreeMed* baropodometry platform and FreeStep by Sensor Medica software in the static and dynamic phase;
- qualitative evaluation of technical-tactical nature of the forehand and backhand topspin attack, consisting of 5 tests from ball with effect (backspin type) and without effect;
- evaluation of the angles between the arm-forearm and the time required to execute the topspin attack, performed with the DartFish 360S biomechanical analysis software;
- evaluating the life quality with the help of the Nottingham Health Profile (NHP) standard questionnaire.

In this stage, we have used the milling machine Vulcan – Vx1 by Sensor Medica, (***) in order to make the individualized orthotic insoles after the initial evaluation of the foot plantar in dynamic phase with the FreeMed baropodometry platform.

With the gathered data from the initial tests, we started producing the individualized orthotic insoles and we devised an individualized amelioration protocol applied to the athletes from the experiment group, involved in the experimental research that we had carried out.

15.8. The objectives of global amelioration intervention protocols

For the individualized global amelioration intervention, we have considered it opportune to improve in the first phase the plantar imbalances and then the postural deficiencies in the frontal and sagittal plan, through a strategy composed of the following

means and objectives.

15.9. The experimental approach

The purpose of this research was to ameliorate the postural deficiencies and plantar imbalances detected after the initial evaluation at this age category.

We have implemented an amelioration protocol, adapted and individualized for the subjects within the experiment group, alongside a qualitative evaluation of a technical-tactical nature of the topspin attack and the biomechanics of its execution.

The amelioration intervention applied to the experiment group was implemented for 5 months due to the necessary time to use the orthotic insoles in order to optimize the foot plant architecture and the body posture.

The amelioration protocol was implemented on nine junior III, between the age of 10 – 12 years, registered and participants within the Federation.

15.9.1. Amelioration protocol description and details

The orthotic insoles are made from polyurethane foam, done by milling with the help of the *Vulcan - $V_{x1,}$ by Sensor Medica* device, after the initial test in the dynamic phase of each subject in the experiment group within the integrative medicine clinic, “Sănătate cu Ozon”, located in Galati, pe str. Domnească, no. 118.

The action systems done by the experiment group have been individualized according to the convexity and concavity of the curvature encountered in each subject after the initial postural evaluation from the frontal and sagittal plan. These were implemented after the preparatory part related to the specific training of table tennis.

Table no. 12. - The action systems implemented to the subject B.D. related to the experiment group

Nr. crt.	Demonstration	Description of the action system	Notes and explanations	Movement type & speed	No. of series/ repetitions		Type - duration of the break and *minutes of execution*
					towards left	towards right	
1.		**Initial position** – In orthostatism, the lower limbs spaced apart in the frontal plan, the upper limbs in abduction, extended (parallel to the ground). Perform the lateral bending of the torso by raising the opposite arm vertically and lowering the other (the arms are on the same line with the shoulders) - frontal plan. **Return to the initial position**	- Apart, on the deep expiration phase, the lateral bending of the trunk to the left is performed. - lateral bending is performed only from the thoracic region, and the bony pelvis and lumbar region should be blocked. - the right upper limb is oriented laterally, correctly balancing and stabilizing the completion of the movement; - in the lateral bending motion, the thoraco-lumbar erector muscles, the antero-postero-superior dentate muscle, and the great dorsal are activated simultaneously with the hip extensors on the same side; - after the 5 seconds of apnea, inhale, and on expiration, pass controlled in the initial position; - performing the alternative exercise.	Active *&* 25%	1 series x 5 repetitions with holding for 5 seconds (on apnea); + 1 series x 3 repetitions with holding for 5 seconds (on apnea);	1 series x 7 repetitions with holding for 5 seconds (on apnea); + 1 series x 5 repetitions with holding for 5 seconds (on apnea);	Passive: 10 seconds & 5 minutes

2.	  	**Initial position** – In orthostatism, the upper limbs extend alongside the body. The trunk is flexed on the pelvis, with the arms leading, grabbing with the hands the popliteal muscle or the gastrocnemius muscle (as the case may be) - sagittal plan. **Return to the initial position**	- From orthostatism, on the expiration phase, the trunk is flexed on the pelvis. - as we flex the torso, the activity of the spinal erector muscles and hamstring muscles intensifies; - all the resistance of maintaining the trunk is taken over by the ligaments of the spine, discs and posterior joints; - the stress of the vertebral plate from the maximum flexion position is slightly reduced, therefore it will not be maintained for a long time, and in our case, the flexion of the trunk will need to be slow; - the posterior muscles and ligaments stretch and all the internal organs are massaged; - in the expiration phase, the postero-inferior dentition, the internal intercostals and the abdominal muscles participate through their action of lowering the ribs; - on the expiration the torso is directed with support and		1 series x 5 repetitions with holding for 20 seconds.	Passive - 15 seconds & 5 minutes

			impulse of the upper limbs on the bent knees; - in the return movement, the lumbar thoracic erector muscles and the lumbar quadrant are agonists;			
3.	 	**Initial position** - In orthostatism, the upper left limb on the side of the concavity, the elbow flexed (forearm in pronation) and the support hand at the level of the lateral iliac crest, the other upper limb is next to the body. The lower limbs are bent at about 30-40 ° and the trunk is sticking to the wall. The retroversion of the pelvis is performed simultaneously with	- From orthostatism, on the expiration phase, the knee joint is flexed. - the retroversion is performed at the level of the pelvis (delordosis at the lumbar level) simultaneously with the shoulder joint projected backwards and the chin in the chest (delordosis at the cervical level); - the contraction of both lower limbs, the spinal erector muscle, the lumbar square and the thoracolumbar fascia act to relax; - on the expiration, support the palms of the knees and straighten the torso.		2 series x 7 repetitions with holding for 20 seconds.	Passive: 10-15 seconds & 5 minutes

		the lowering of the chin towards the chest - frontal plan. **Return to the initial position**					
4	  	**Initial position** – In orthostatism, facing the wall, we perform a forward abduction of the lower left limb, the hand in pronation, sticking to the wall. The subject performs with the lower limb as a rotation to the left - transverse plan. **Return to the initial position**	- From orthostatism, the left upper limb is in lateral abduction in order to stretch the osteo-muscular-articular system on the concavity side. - on the expiration phase, it is performed with the upper limb as a rotation to the left, to prevent the costal ghibus; - in the expiration phase, the great round muscle, the subspinous, the rhomboid and the superior trapezius stretch; - after 5 seconds, inhale and exhale to the starting position, then perform the same exercise on the same side.	Active ***&*** 25%	With the left lower limb in lateral abduction; 3 series x 10 repetitions with holding for 5 seconds.	With the right lower limb in lateral abduction; 3 series x 3 repetitions with holding for 5 seconds.	Passive: 10-15 seconds & 5 minutes

CHAPTER 16.
INTERPRETING THE EXPERIMENTAL RESEARCH RESULTS

16.2. Final evaluation of the subjects (experiment group and control group)

We will present the values obtained within the final test in the case of the two groups included in the scientific research:

16.2.1. Medical-sports history (initial test – final test)

We identify ameliorating values obtained in the final test regarding pain perception at athletes from the experiment group, especially on the lumbar region with a percentage of 77.78% (out of 9 subjects, only 2 presented pain) and total regression of pain of – 51.53%, which shows the efficiency of the improvement protocol implemented over a period of 5 months. The data is gathered with help of the Anamnesis from the Personal history section.

16.2.2. Anthropometric and specific tests evaluation (initial test – final test)

There are differences in percentage growth resulting from the average values from the initial and final tests. It shows for the waist of the athletes in the experiment group an increase of 3.72% for biacromial diameter by 2.53%, while chest elasticity has a difference of 4.09%. The subjects are in a period of growth, the specific percentages for this age category, which we consider are in accordance with the characteristics of the period that the juniors III go through.

16.2.3. Postural evaluation in frontal and sagittal plan (initial test – final test)

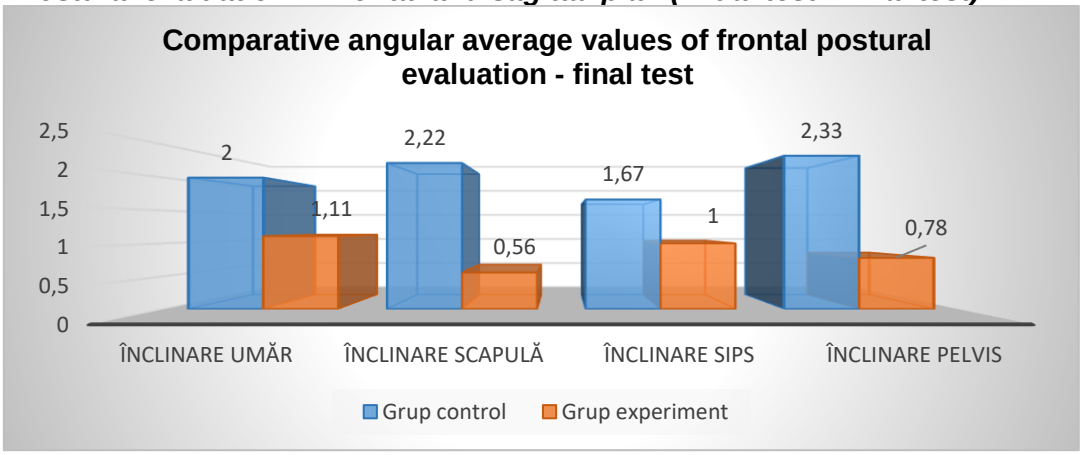

Chart no. 2. - Comparative values obtained within the frontal postural evaluation of the control group compared to the experiment (final test)

Table no. 13. - Comparison of frontal angular postural values from the initial test and the final test to the experiment group

Analyzed feature / Anatomical references	No. subjects	Average values at initial test	Average values at the final test	Percentage difference
Shoulder tilt º	9	2.22	1.11	-50.00%
Scapula tilt º	9	2.56	0.56	-78.28%
P.S.I.S. tilt º	9	3.56	1	-71.91%
Pelvic tilt º	9	2.78	0.78	-71.94%
Average percentage difference				-68.03%

In table no. 7 related to the experiment group, we can see that after applying the amelioration protocol, all postural indices were optimized with an average percentage of 68%,

resulting in a better posture. Therefore, we consider it important to detect early postural deficiencies and the proper implementation of individualized action systems and individualized orthotic insoles.

Table no. 14. - Comparison of postural angular values in the sagittal plan from the initial test and the final test of the experiment group

Analyzed feature / Anatomical references	No. subjects	Average values at initial test	Average values at the final test	Percentage difference
Cervical arch C3 (mm.)	9	64	63.44	-0.88%
Lumbar arch L3 (mm.)	9	63.11	56.22	-10.92%
Average percentage difference				-5.90%

We can see that after applying the amelioration protocol in sagittal plan, at lumbar level, it resulted in the regression of hyperlordsosis (-10.92%) and an improvement of about -1% at the cervical level.

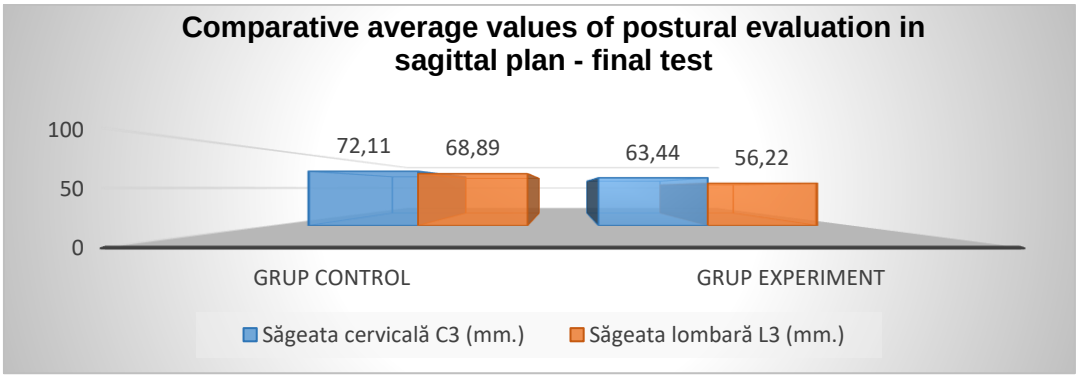

Chart no. 3. - Comparative values obtained in the postural evaluation from the sagittal plan on the control group compared to the experiment (final test)

16.2.4. Plantar evaluation in the static and dynamic phase (initial test – final test)

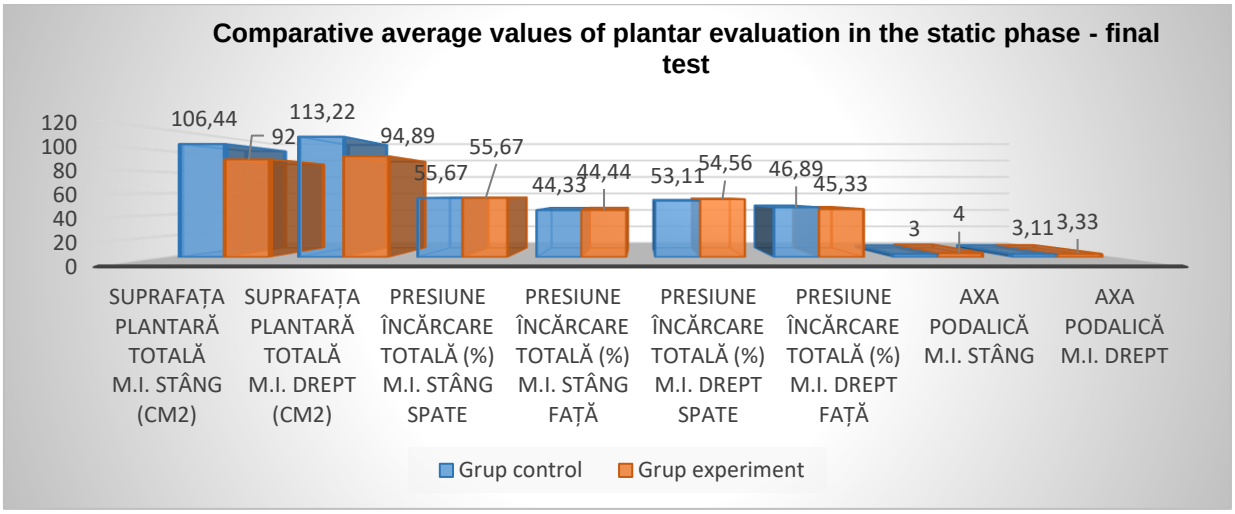

Chart no. 4. - Comparative values regarding the static plantar evaluation in the experiment group vs. control group

The numerical values highlighted in the previous chart, regarding the static plantar

support mode highlight a close value in relation to the standard (110 cm^2) at the level of the plantar surfaces, a situation that validates the efficiency of the individualized orthotic insoles. Moreover, the values of the pressure made on the foot's plantar for the experiment group (final test) are within the standard with a value of the back left lower limb – 55% vs. standard (55%) and 44.4% (front) vs. the standard value of 45%.

Table no. 15. - Comparison of the values on static planting characteristics from the initial and final test of the experiment group

Analyzed feature / Anatomical references	**No. subjects**	**Average values at initial test**	**Average values at final test**	**Percentage difference**
Total plantar area of the left lower limb (cm^2)	9	60.67	92	52%
Total plantar area of the right lower limb (cm^2)	9	64.22	94.89	48%
Full load pressure (%) lower left limb Back	9	60.22	55.67	-8%
Full load pressure (%) lower left limb Front	9	39.78	44.44	12%
Full load pressure (%) lower right limb Back	9	57.22	54.56	-5%
Full load pressure (%) lower right limb Front	9	39.78	45.33	14%
Podal axis lower left limb	9	3.22	4	24%
Podal axis lower right limb	9	2.56	3.33	30%

We identify at the experiment group an increase of the plantar surface with a percentage difference of 52% on the left foot plantar and 48% on the right foot plantar, aspects which show a significant optimization of the support surface as a result of the implementation of the individualized orthotic insoles, thus the values getting closer to the reference (110%). These increases of the plantar surfaces have led to a solid base of the foot plantar architecture, improving the postural parameters.

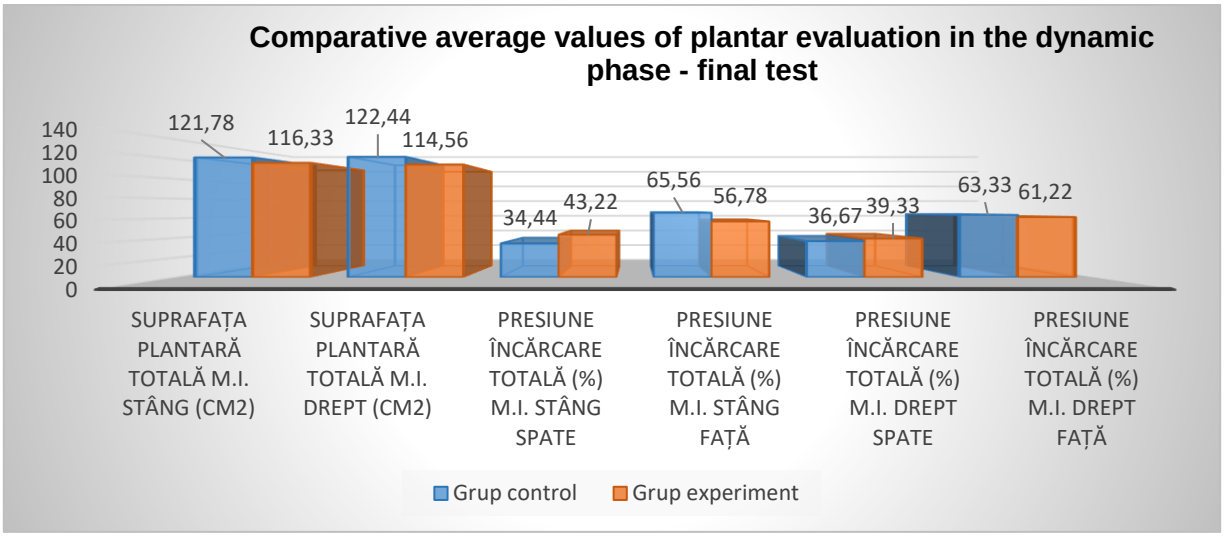

Chart no. 5. - Comparative values regarding the dynamic plantar evaluation in the experiment group vs. control group

It can be seen that the values of the control group are closer to those of the reference values, but the pressure of the foot plantar architecture does not fit in the standard, while the experiment group presents an improvement of the plantar surfaces, as well as the pressures performed on the support surface.

Table no. 16. - Comparison of values on dynamic planting characteristics from the initial test and the final test in the experiment group

Analyzed feature / Plantar parameters	No. subjects	Average values at initial test	Average values at final test	Percentage difference
Total plantar area lower left limb (cm^2)	9	87.11	116.33	33.54%
Total plantar area lower right limb (cm^2)	9	87	114.56	31.67%
Full load pressure (%) lower left limb Back	9	37	43.22	16.81%
Full load pressure (%) lower left limb Front	9	63	56.78	-9.87%
Full load pressure (%) lower right limb Back	9	37.33	39.33	5.36%
Full load pressure (%) lower right limb Front	9	62.67	61.22	-2.31%

The initial values in dynamic of the experiment group have undergone improvements mainly on the plantar surfaces, bringing them closer to the reference ones, which demonstrates and validates the importance of implementing orthotic insoles at this age, as well as respecting the recommendation on how to handle them by the subjects, which ultimately led to a balance at the plantar level.

A **B** **C**

Figure no. 3. - A part of the subjects from the experiment group and the orthotic insoles that they wore them during the actual research

The other images with the athletes related to the experiment group can be found in annex no. 32.

16.2.5. Technical-tactical and biomechanical evaluation of the topspin attack (initial test – final test)

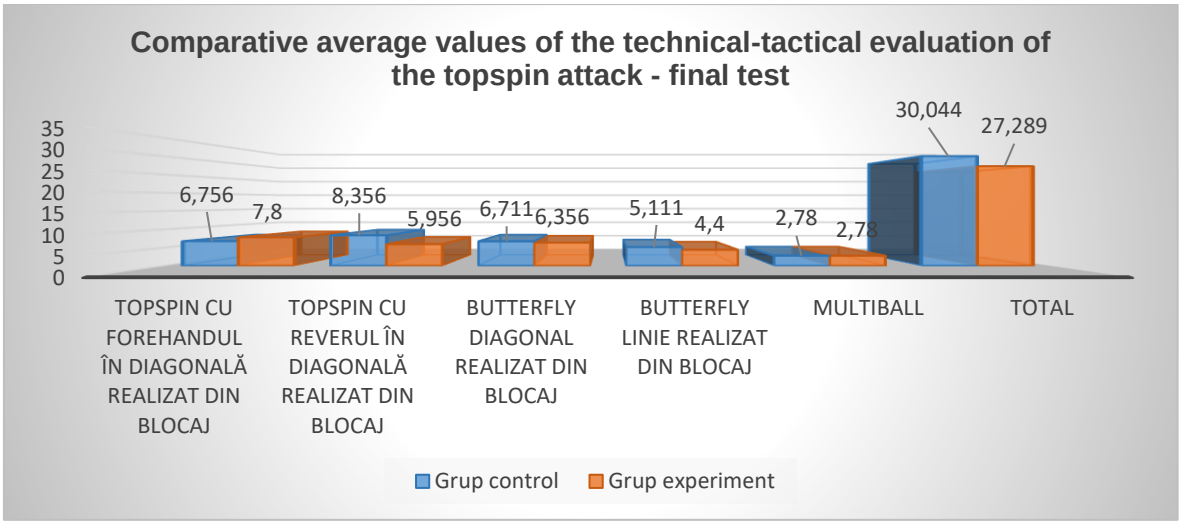

Chart no. 6. - Comparative average values obtained during the qualitative technical-tactical evaluation of the topspin attack in the final test

We identify in the case of the *forehand topspin* an increase of the experiment group, the highest amplitude regarding the twisting of the trunk being achieved on this side of the strike, the better qualitative level being able to be the result of the improvement protocol. In the case of the *multiball* test, similar values as general value for the control group, presenting a plus materialized through almost 3 units.

Table no. 17 - Comparison of topspin attack quality values from initial and final test in the experiment group

Analyzed feature / Tests	**No. subjects**	**Average values at initial test**	**Average values at final test**	**Percentage difference**
Topspin with diagonal forehand done from blocking	9	5.02	7.8	55.32%
Topspin with diagonal backhand done from blocking	9	6.11	5.96	-2.54%
Diagonal butterfly done from blocking	9	4.36	6.36	45.91%
Line butterfly done from blocking	9	3.18	4.4	38.45%
Multiball	9	2.33	2.78	19.31%
Total	9	20.3	27.29	**34.43%**

The qualitative level of the topspin attack in the experiment group registers a considerable increase of 34%, the significant leap being presented at the level of the *forehand topspin* test (55%) and the *diagonal butterfly made from blocking* (19%). Moreover, and in the combined test named *multiball*, a qualitative amelioration can be seen, validated by the 19%, a situation that can be due also to the lack of pain.

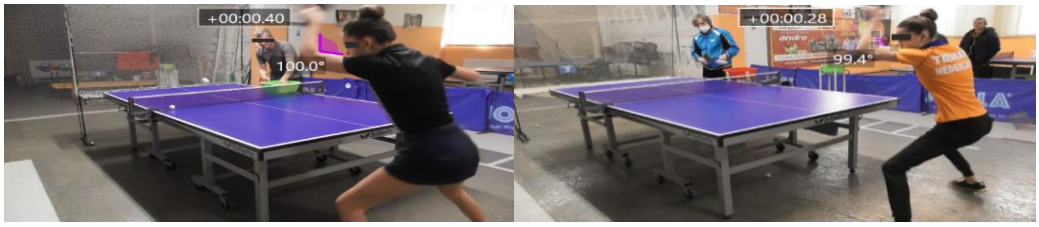

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Figure no. 4. - Biomechanical and time aspects specific to the topspin with the forehand within the multiball test from the initial and final test

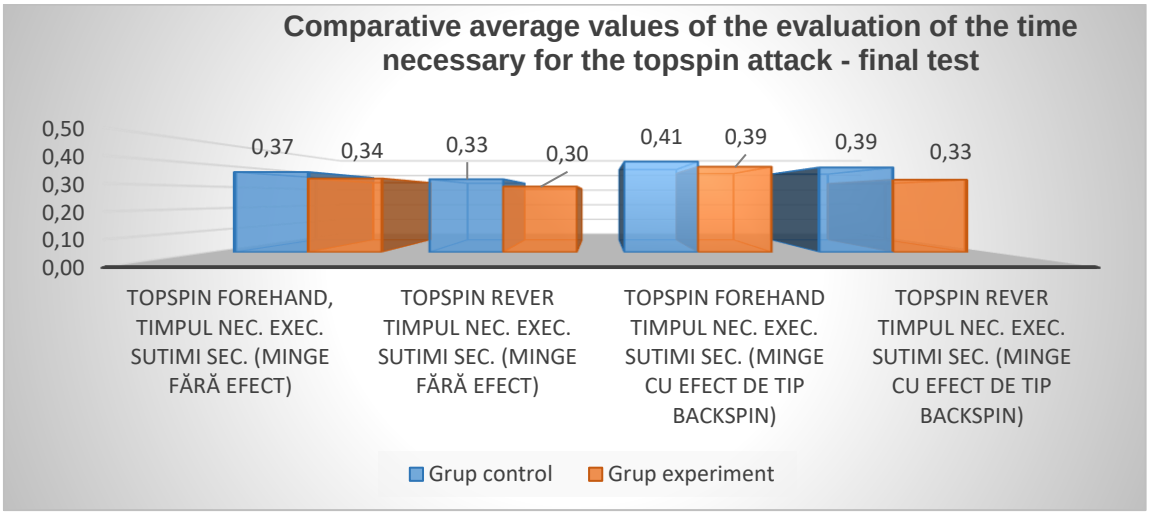


Chart no. 7. - Comparative values of the technical-tactical procedures analysed from the point of view of the necessary execution time

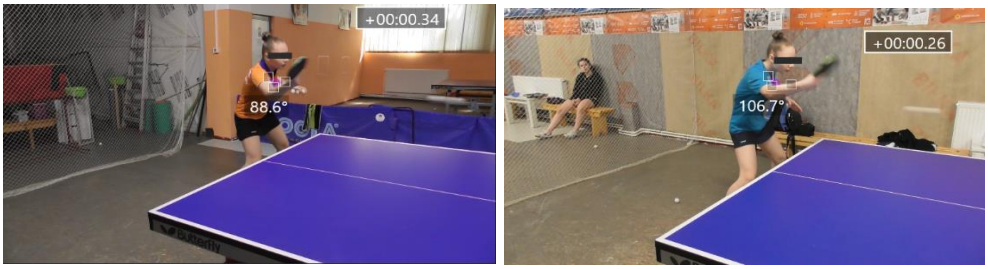
In the case of the values that express the necessary time to perform the topspin attack, a higher value indicates a lower efficiency in time, while a lower value indicates better efficiency. Therefore, for all 4 procedures in the case of the experiment group we have a superior execution time than that of the control group.

Table no. 18. - Comparative mean values of biomechanical evaluation and time necessary to perform the topspin attack for the experiment group at the initial test - final test

Component stages of the execution of the technical-tactical procedure / execution time	**Average values at initial test**	**Average values at final test**	**Percentage difference**
Topspin FHD, Commencing strike <º (ball without effect)	131.96	133.26	0.99%
Topspin FHD, Actual strike <^{0} (ball without effect)	104.29	103.84	-0.43%
Topspin FHD, Ending the movement <º (ball without effect)	101.79	83.96	-17.52%
Topspin FHD, Time required to execute hundreds of sec. (ball without effect)	0.38	0.34	**-11.30%**
Topspin BHD., Commencing strike <º (ball without effect)	94.989	95.656	0.70%
Topspin BHD., Actual strike <º (ball without effect)	108.978	115.09	5.61%
Topspin BHD., Ending the movement <º (ball without effect)	142.211	156.07	9.75%
Topspin REV., Time required to execute hundreds of sec. (ball without effect)	0.3444	0.29	**-15.80%**
Topspin FHD Commencing strike <º (ball with backspin effect)	160.222	144.18	-10.01%
Topspin FHD Actual strike <º (ball with backspin effect)	114.11	11034.00 %	-3.30%
Topspin FHD Ending the movement <º (ball with	95.12	88.00%	-7.47%

backspin effect)			
Topspin FHD Time required to execute hundreds of sec. (ball with backspin effect)	0.44	39.00%	**-12.24%**
Topspin BHD. Commencing strike <º (ball with backspin effect)	107.70	107.00%	-0.31%
Topspin BHD. Actual strike <º (ball with backspin effect)	117.87	119.99	1.80%
Topspin BHD. Ending the movement <º (ball with backspin effect)	131.744	139.5	5.89%
Topspin BHD. Time required to execute hundreds of sec. (ball with backspin effect)	0.3922	0.3311	**-15.58%**

In the case of the forehand topspin test on the third part of the strike (the ending movement) an improvement of approximately 18% can be seen and the time necessary for execution has progress materialized in a percentage of 11%. An optimization of biomechanics in the sense of reducing the angular values at the topspin test with backspin forehand by 20% on the three stages of strike favored an improvement of the execution time by 12%.



A B

Figure no. 5. - Biomechanical and time aspectcs specific to the *backhand topspin* in the *multiball* test in the initial and final test

16.2.6. Athletes' life quality (initial test and final test)

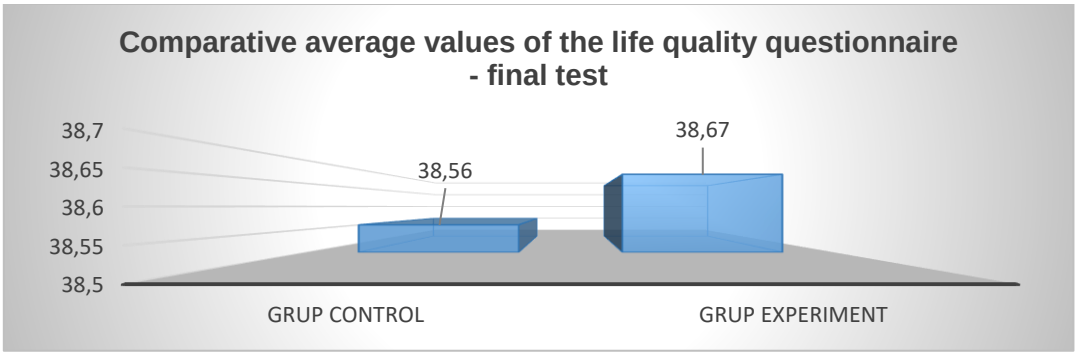


Chart no. 8. - Comparative average values obtained in the qualitative evaluation of life in the final test

It can be observed that in the control group from the manifestation performed by the applied standard questionnaire it presents according to the numerical value a life quality level close to the experiment group in relation to the optimal reference value (38) compared to the lowest value (76).

16.3. Statistical-mathematical processing and analysis of the data from the initial and final test

The multitude of data obtained in the tests applied for the control and experiment groups

has facilitated the calculation of some statistical-mathematical coefficients meant to highlight the existing correlations. Their level and the homogeneity of the groups subjected to the scientific research are presented for anamnesis, anthropometry and related tests, body and plantar posture, life quality, biomechanics, and execution time, along with the technical-tactical qualitative level of the topspin attack. From this statistical processing with the help of the IBM SPSS software vers. 23, it results in beneficial conclusions both at the scientific level, as well as at the level of sports training for performance.

In this subchapter, we consider that it is relevant to highlight the statistical indicators together with the most important correlations:

z (t) test, ANOVA test, average value, standard deviation, standard error, pearson correlation coefficient.

Table no. 19. - Anova test results for postural evaluation in the frontal plan

Analyzed feature / Anatomical references		**Sum of the squares**	**df**	**Average of the squares**	**F**	**Sig.**
Shoulder - angle tilt	Between groups	8.306	3	2.769	1.466	.242
	Within the groups	60.444	32	1.889		
	Total	68.750	35			
Scapula – angle tilt (v.p.)	Between groups	21.000	3	7.000	4.000	.016
	Within the groups	56.000	32	1.750		
	Total	77.000	35			
P.S.I.S. – angle tilt (v.p.)	Between groups	37.889	3	12.630	5.381	.004
	Within the groups	75.111	32	2.347		
	Total	113.000	35			
Pelvic – angle tilt (v.a.)	Between groups	20.444	3	6.815	5.305	.004
	Within the groups	41.111	32	1.285		
	Total	61.556	35			

There are significant differences between group averages ($p < 0.05$) for:

- ✓ scapula – angle tilt (v.p.) ($p = 0.016$);
- ✓ P.S.I.S. – angle tilt (v.p.) ($p = 0.004$);
- ✓ Pelvic – angle tilt (v.a.) ($p = 0.004$).

Within the postural evaluation in the frontal plan, we have applied the *z test* for one group, with the purpose to highlight the difference between the average of the postural values of the subjects in the experiment group compared to the reference value, which is 0.

Table no. 20. - Descriptive statistics for the experiment group on frontal postural evaluation vs. reference value

Analyzed feature / Anatomical references	**Reference value = 0°**					
	t	**Df**	**Sig. (2-tailed)**	**Average difference**	**95% confidence interval for the average**	
					Lower edge	**Top edge**
Shoulder - angle tilt° (v.p.)	3.592	8	0.007	1.111	.40	1.82
Scapula – angle tilt° (v.p.)	1.890	8	0.095	0.5556	-.122	1.233
P.S.I.S. – angle tilt° (v.p.)	3.000	8	0.017	1.0000	.231	1.769
Pelvic – angle tilt° (v.a.)	2.135	8	0.065	0.778	-.06	1.62

Because in the case of the tilt angles of the shoulder and postero-superior iliac spine, Sig.(2-tailed) or $p < \alpha = 0.05$ ($p = 0.007$, respectively $p = 0.017$) and because the limits of the confidence interval for the difference between the sample mean and the reference value (95% CI) does not contain the zero value, it results that **there are differences** between the values of the athletes in the experiment group and the reference value, but we highlight the regression of the values at the level of all postural indices.

Table no. 27. - Descriptive statistics for the experiment group on postural evaluation from the sagittal plan (cervical arch) in the final test

Analyzed feature / Anatomical references	**Reference value = 65 mm.**					
	t	df	Sig. (2-tailed)	Average difference	95% confidence interval for the average	
					Lower edge	Top edge
Cervical arch C3 (mm.)	-0.430	8	0.678	-1.556	-9.89	6.78

From the z test, it results in Sig.(2-tailed) or $p = 0.678 > \alpha = 0.05$, and because the confidence interval for the difference between the sample mean and the reference value (95% CI) contain the value zero, it results that **there are NO differences between the mean value of the experiment group for the cervical arch C3 and the considered reference value** (65).

Table no. 21. - Descriptive statistics for the experiment group on postural evaluation from the sagittal plan (lumbar arch)

Analyzed feature / Anatomical references	**Reference value = 45 mm.**					
	t	**df**	**Sig. (2-tailed)**	**Average difference**	**95% confidence interval for the average**	
					Lower edge	**Top edge**
Lumbar arch L3 (mm.)	4.638	8	0.002	11.2222	5.642	16.802

The z test shows that **there are differences between the mean value of the experiment group for the lumbar arch L3 and the reference value** (45) because Sig.(2-tailed) or $p = 0.002 < \alpha = 0.05$ and the limits of the confidence interval for the difference between the sample mean and the reference value (95% CI) do not include the zero value. An

important aspect to be mentioned, because we have discovered a regression of lumbar hyperlordosis at the final test compared to the initial test, by about 11%.

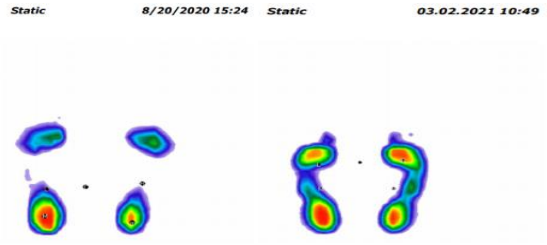


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Figure no. 6. - Comparative image of athlete S. P. (experiment group) on plantar evaluation in the static phase (A – initial test and B – final test)

We highlight important changes at the level of the plantar surface of one of the athletes from the experiment group predominantly on the right plantar arch (final test – 101 cm^2 vs. initial test – 7 cm^2) and left (final test – 98 cm^2 vs. initial test – 8 cm^2), aspects influenced by wearing the individualized orthotic insoles.

Table no. 22. - Anova test results for plantar evaluation in the static phase

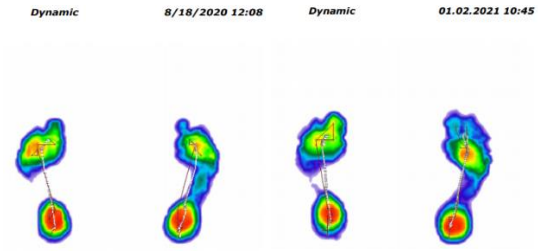
Analyzed feature / Plantar parameters		**Sum of the squares**	**df**	**Average of the squares**	**F**	**Sig.**
Total plantar surface lower left limb (cm^2)	Between groups	9958.222	3	3319.407	6.477	0.001
	Within the groups	16399.778	32	512.493		
	Total	26358.000	35			
Total plantar surface lower right limb (cm^2)	Between groups	11258.000	3	3752.667	5.226	0.005
	Within the groups	22980.222	32	718.132		
	Total	34238.222	35			
Total load pressure (%) lower left limb Back	Between groups	179.417	3	59.806	0.825	0.490
	Within the groups	2319.556	32	72.486		
	Total	2498.972	35			
Total load pressure (%) lower left limb Front	Between groups	181.111	3	60.370	0.831	0.487
	Within the groups	2323.778	32	72.618		
	Total	2504.889	35			
Total load pressure (%) lower right limb Back	Between groups	113.889	3	37.963	0.385	0.764
	Within the groups	3152.667	32	98.521		
	Total	3266.556	35			
Total load pressure (%) lower right limb Front	Between groups	326.556	3	108.852	1.001	0.405
	Within the groups	3478.444	32	108.701		
	Total	3805.000	35			
Pedal axis lower	Between groups	5.000	3	1.667	.265	0.850

left limb	Within the groups	201.556	32	6.299		
	Total	206.556	35			
Pedal axis lower right limb	Between groups	50.889	3	16.963	.928	0.439
	Within the groups	585.111	32	18.285		
	Total	636.000	35			

From the ANOVA table, we can see that there are significant differences between the 4 analyzed groups ($p < 0.05$) for:

- ✓ total plantar surface lower left limb (cm^2) ($p = 0.001$);
- ✓ total plantar surface lower right limb (cm^2) ($p = 0.005$).

Within the plantar evaluation in the static phase, we have applied the *z test* for one group with the purpose to highlight the difference between the total plantar surface of the athletes from the group experiment than the reference value of 110 cm^2, according to the value data from table no. 30.



A B

Figure no. 7. - Comparative image of athlete G.D. (experiment group) on plantar evaluation in the dynamic phase (A – initial test and B – final test)

We highlight important changes at the level of the plantar surface, in the dynamics of one of the athletes from the experiment group, especially on the right plantar arch (final test – 122 cm^2 vs. initial test – 92 cm^2) and left (final test – 122 cm^2 vs. initial test – 80 cm^2), aspects influenced by wearing the individualized orthotic insoles.

Table no. 23 - Anova test results for the plantar evaluation in the dynamic phase

Analyzed feature / Plantar parameters		**Sum of the squares**	**df**	**Average of the squares**	**F**	**Sig.**
Total plantar surface lower left limb (cm^2)	Between groups	6412.556	3	2137.519	3.386	.030
	Within the groups	20202.000	32	631.313		
	Total	26614.556	35			
Total plantar surface lower right limb (cm^2)	Between groups	6467.639	3	2155.880	3.352	.031
	Within the groups	20583.333	32	643.229		
	Total	27050.972	35			
Total load pressure (%) lower left limb Back	Between groups	372.222	3	124.074	1.997	.134
	Within the groups	1987.778	32	62.118		
	Total	2360.000	35			
Total load	Between groups	372.222	3	124.074	1.997	.134

pressure (%) lower left limb Front	Within the groups	1987.778	32	62.118		
	Total	2360.000	35			
Total load pressure (%) lower right limb Back	Between groups	120.000	3	40.000	1.889	.151
	Within the groups	677.556	32	21.174		
	Total	797.556	35			
Total load pressure (%) lower right limb Front	Between groups	97.639	3	32.546	1.699	.187
	Within the groups	613.111	32	19.160		
	Total	710.750	35			

By processing the data obtained at the level of plantar surface, *we can see significant differences* between the 4 analyzed groups ($p < 0.05$) registered for:

- *total plantar surface lower left limb (cm^2) ($p = 0.030$);*
- *total plantar surface lower right limb (cm^2) ($p = 0.031$).*

Within the plantar evaluation in the dynamic phase, we have applied the *z test* for one group with the purpose of highlighting the difference between the total plantar surface of the athletes from the experiment group than the reference value of *120 cm^2*, according to the value data from table no. 104.

Table no. 24. - Descriptive statistics for the experiment group on plantar evaluation in the dynamic phase of the final test

Analyzed feature / Plantar parameters	**Reference value = 120 cm^2**					
	t	**df**	**Sig. (2-tailed)**	**Average difference**	**95% confidence interval for the average**	
					Lower edge	**Top edge**
Total plantar surface lower left limb(cm^2)	-.880	8	0.405	-3.667	-13.28	5.94
Total plantar surface lower right limb (cm^2)	-1.424	8	0.192	-5.4444	-14.260	3.371

Because Sig.(2-tailed) or $p = 0.405 > \alpha = 0.05$ for the left foot, respectively $p = 0.192 > \alpha = 0.05$ for the right foot and taking into account that the confidence interval limits for the difference between the sample mean and reference value (95% CI) contains the zero value, it results that there are NO significant differences between the total plantar surface of the athletes from the experiment group and the reference value, both for the right foot, as well as for the left foot.

Table no. 25. - Anova test results for the qualitative evaluation of the topspin attack

Component stages of the technical-tactical tests		**Sum of the squares**	**df**	**Average of the squares**	**F**	**Sig.**
Topspin with diagonal forehand done from	Between groups	46.777	3	15.592	0.956	0.425

blocking	Within the groups	522.053	32	16.314		
	Total	568.830	35			
Topspin with diagonal backhand done from blocking	Between groups	42.066	3	14.022	1.007	0.402
	Within the groups	445.493	32	13.922		
	Total	487.559	35			
Diagonal butterfly done from blocking	Between groups	31.396	3	10.465	0.803	0.501
	Within the groups	416.853	32	13.027		
	Total	448.249	35			
Line butterfly done from blocking	Between groups	25.107	3	8.369	1.534	0.225
	Within the groups	174.613	32	5.457		
	Total	199.720	35			
Multiball	Between groups	3.000	3	1.000	0.327	0.806
	Within the groups	98.000	32	3.063		
	Total	101.000	35			
TOTAL	Between groups	549.943	3	183.314	1.447	0.248
	Within the groups	4054.373	32	126.699		
	Total	4604.316	35			

For all the studied variables we have associated probability (Sig. column from the table) higher than the significant limit of 0.05 (p = 0.425 for the topspin with diagonal forehand done from blocking, p = 0.402 for the topspin with diagonal backhand done from blocking, p = 0.501 for the diagonal butterfly done from blocking, p = 0.224 for the line butterfly done from blocking, p = 0.80 for the multiball, and p = 0.248 for the total), it results that there are significant differences between the average values of the variables between the 4 analyzed groups.

Table no. 26. - Anova test results for the biomechanics evaluation of the topspin attack

Component stages of the execution of the technical-tactical procedure / execution time		**Sum of the squares**	**df**	**Average of the squares**	**F**	**Sig.**
Topspin FOREHAND, End of the movement <º (ball without effect)	Between groups	2630.039	3	876.680	3.810	0.019
	Within the groups	7362.951	32	230.092		
	Total	9992.990	35			
Topspin BACKHAND	Between groups	.022	3	.007	3.541	.025

Time necessary for execution hundreds of sec. (ball without effect)	Within the groups	.066	32	.002		
	Total	.088	35			
Topspin FOREHAND Commencing strike <º (ball with backspin effect)	Between groups	2574.733	3	858.244	3.024	.044
	Within the groups	9082.162	32	283.818		
	Total	11656.896	35			

The results from the ANOVA table indicate that there are significant differences between the 4 analyzed groups ($p < 0.05$) for:

- topspin FOREHAND, End of the movement <º (ball without effect) ($p = 0.019$);
- topspin BACKHAND Time necessary for execution hundreds of sec. (ball without effect) ($p = 0.025$);
- topspin FOREHAND Commencing strike <º (ball with backspin effect) ($p = 0.044$).

Table no. 27. - Anova test results for the life quality evaluation

	Sum of the squares	**df**	**Average of the squares**	**F**	**Sig.**
Between groups	34.444	3	11.481	5.072	0.006
Within the groups	72.444	32	2.264		
Total	106.889	35			

The ANOVA table contains the results of the test: : $F = 5.072$; $p = 0.006 < alfa = 0.05$. Under these conditions, it is accepted that the values of the scores on the Nottingham questionnaire differ significantly from each other for at least two of the studied groups.

Table no. 28. - Descriptive statistics for the experiment group on the evaluation of the quality of life for the final test

Points obtained after the interview	**Reference value = 38 points**					
					95% confidence interval for the average	
	t	**df**	**Sig. (2-tailed)**	**Average difference**	**Lower edge**	**Top edge**
TOTAL POINTS	1.789	8	.111	.667	-.19	1.53

After conducting the ***z test***, in the final test, Sig.(2-tailed) or $p = 0.111 > \alpha = 0.05$ and the confidence interval limits for the difference between the group average and reference value (95% CI) contain the zero value, it results that there are ***NO differences between the average value of the number of points in the questionnaire for improving the life quality and the value considered the best*** (38) **for the experiment group**, which denotes the improvement of life quality in the case of this group compared to the initial test.

16.3.1. Analysis of correlations resulting from evaluation (initial test – final test)

We have identified a series of significant correlations between the differences of the initial and final test related to the experiment group that validates our concept. We identified conclusions from an informational point of view, which can constitute a beneficial base for the table tennis specialists for this age category, highlighting the most important in the next tables.

Table no. 29. – Correlations regarding body posture (frontal plan) and the technical-tactical success of the topspin attack

ANATOMIC REFERENCE - TOPSPIN FOREHAND	**Pearson correlation coefficient r**	**Associated probability p**
P.S.I.S. tilt <º - Topspin FHD. in diagonal done from blocking	- 0.824	0.006

In this case, we have an inversely proportional ratio with the following significance: a lower value of the postero superior iliac spine inclination implies a superior success of the diagonal FHD Topspin test done from blocking (r= - 0.824).

Table no. 30. - Correlations on body posture (frontal plan) and biomechanics of topspin attack

ANATOMICAL REFERENCES - TOPSPIN FOREHAND AND BACKHAND	**Pearson correlation coefficient r**	**Associated probability p**
Shoulder tilt<º - Topspin FHD. actual strike <º (ball with backspin effect)	- 0.819	0.007
Pelvic tilt <º - Topspin BHD. actual strike <º (ball without effect)	- 0.671	0.08

In the first case, we have an inversely proportional correlation which results in a lower value of the *shoulder tilt* (<º) and involves better *biomechanics of the topspin FHD. in striking the ball (with effect)*, and for the 2 correlation, we also have an inversely proportional ratio with the following signification: *a lower value of the pelvic tilt* (<º) *involves better biomechanics of the topspin in striking the ball without effect.*

Table no. 31. - Correlations regarding the architecture of the foot plant (dynamic phase), the technical-tactical and biomechanical success of the topspin attack

PLANTAR PARAMETERS - TOPSPIN FOREHAND AND BACKHAND	**Pearson correlation coefficient r**	**Associated probability p**
Total plantar surface lower left limb (cm2) - Topspin with BHD. in diagonal done from blocking	0.790	0.011
Total load pressure (%) lower left limb front Topspin BHD. end of the movement <º (ball without effect)	- 0.696	0.037
Total load pressure (%) lower right limb front Topspin BHD. commencing strike <º (ball without effect)	0.952	0.001

The values mentioned in this table show strong correlations and the influences exerted by the total plantar surface and the pressure loaded on the technical-tactical and biomechanical success in the topspin attack.

Table no. 32. - Correlations regarding the foot plant architecture (dynamic phase) and the execution time of the topspin attack

PLANTAR PARAMETERS - TOPSPIN FOREHAND AND BACKHAND	**Pearson correlation coefficient**	**Associated probability**

	r	p
Total plantar surface lower left limb (cm2) - Topspin BHD., time necessary for execution hundreds of sec. (ball without effect)	- 0.681	0.043
Total load pressure (%) lower right limb front - Topspin forehand, time necessary for execution hundreds of sec. (ball without effect)	- 0.718	0.029

The correlations mentioned within this table highlight the influences made by the total surface (cm^2) and the total pressure of the lower left limb upon the execution time related to the topspin attack.

CHAPTER 17.
CONCLUSIONS OF THE EXPERIMENTAL RESEARCH

The research results have proven that the first hypothesis according to which by using a new evaluation and amelioration methodology based on a postural plantar compensation protocal will favourably improve the quality of the topspin attack in the game of table tennis was confirmed by the following results, after the amelioration protocol was applied:

- in frontal plan, in the case of the experiment group, all postural indices were improved with an percentage average of *68%* with a maximum of *78%* in the case of the scapula and *71%* for P.S.I.S., resulting in a better posture, concluding that these increases are important in the early detection of postural deficiencies, as well as the proper implementation of the action systems after the preparatory part and the introduction of the individualized orthotic insoles;
- moreover, for the control group, we notice an amplification of the postural deficiencies in the frontal plan with a total percentage of approximately *22%*. A situation that we consider it is due to the lack of an postural amelioration protocol for this aggresive growing period and the specific of the discipline in which we have carried out our scientific research;
- the postural amelioration protocol has created, through its efficiency, differences at the level of the groups in the case of the scapula tilt, P.S.I.S. – angle, in terms of the degrees of angles related to body posture, as it resulted from the analysis performed with the Anova test.

In the case of postural deficiencies in sagittal plan, the used means similar to those of the frontal plan have highlighted the following aspects:

- after applying the amelioration protocol, in sagittal plan, at the lumbar level, it resulted in the regression of the hyperlordosis with a percentage of 10.92%, as well as an improvement with 1% of the cervical curve;
- in the case of the control group, the lack of the amelioration protocol has manifested for both arches specific to the cervical-lumbar curve, and in sagittal plan, an increase in lumbar lordosis by 5.62% was highlighted;
- the early detection in the initial phase of the postural plantar deficiencies and the immediate application of the individualized amelioration protocol has represented the key for the final obtained results, especially in frontal plan.

The imbalances met at the plantar level in the static and dynamic phase have been improved with the help of the individualized orthotic insoles, highlighting the following aspects regarding the total surface (cm^2) and the exerted pressures:

- **in the dynamic phase** for the ***experiment*** *group*, the lower left limb has increased with

a percentage of *33.54%* (from 87.11 to 116.33 cm^2) and for the *lower right limb*, an increase with a percentage of *31.67%* (from 87 to 114.56 cm^2), values that highlight the relevance of the individualized orthotic insoles made for this phase;

- **the total exerted pressures** in the case of the ***experiment*** *group*, *in dynamic phase*, the *lower left limb (back)* has increased with a percentage of *16.81%* (from 37% to 43%), and for the *lower left limb (front)* a decrease of *-9.87%* (from 63% to 56%), aspects which fit in the reference values;

We consider that the quality of the topspin attack was positively influenced by the postural and plantar balance by increasing the number of successes by the 5 tests applied in the case of this type of evaluation, highlighting a total significant increase of 34% in the case of the experiment group compared to the control group which registered a progress of only 1.35%, thus confirming hypothesis no. 1.

Significant increase percentages, for the *experiment group*, were gained in the tests:

- topspin with diagonal forehand done from blocking, with a percentage increase of *55%*;
- diagonal butterfly done from blocking, with a percentage increase of approximately *46%*;

For the control group, the quality level of the topspin attack has registered the following values:

- topspin with diagonal forehand done from blocking presented a regress in percentages of approximately *14%*;
- diagonal butterfly done from blocking had a progress of only *4.86%*.

For the evaluation of the biomechanics of the topspin attack execution and the time necessary for executing it, in the case of the component procedures represented by the forehand and backhand strike from ball with effect (backspin) and without effect, the DartFish 360S computer program was the support for this type of evaluation, meant to highlight the occurence of some changes in this plan as a possible result of the postural amelioration protocol.

Therefore, the following changes for the three stages specific for the execution of a strike and its related time have resulted. *For the experiment group*:

- the time necessary to execute the *forehand topspin from ball without effect* has optimized with a percentage of 11.30%, from 0.38 to 0.34 seconds;
- the time necessary to execute the *backhand topspin from ball without effect* has improved with a percentage of approximately 16%, from 0.34 to 0.29 seconds
- the biomechanics of the backhand topspin in the case of striking a ball without effect, an improvement has been presented in the sense of striking it earlier, with a percentage of approximately 6%, from 109º to 115º;
- for the *forehand from ball with backspin effect* execution, a progress of 12% was made, from 0.44 to 0.39 seconds;
- the biomechanics of the backhand topspin, in the case of striking the ball with backspin effect has presented a sensible improvement of 2º, at the level of the arm and forearm in this execution stage;
- the optimization of the execution time for the backhand topspin from backspin has registered a value of approximately 16%, from 0.39 to 0.33 seconds.

In this context, we can conclude that despite the fact that the striking amplitude has increased and the execution time has improved, the freedom of movement at the level of the active upper limb is bigger and the speed of the related muscle contraction is optimized.

For the control group:

- the necessary time to execute the *forehand topspin from ball without effect* procedure has optimized with a percentage of only 1.45%, from 0.386 to 0.380 seconds;
- for the execution of the *forehand from ball with backspin effect*, a progress of only 2.36% was made, from 0.42 to 0.41 seconds;

The lower percentage values in the case of the control group for the execution time of the technical-tactical procedure from a biomechanical point of view can be the result of the permanent presence of pain reported by the athletes at the knee joint level and the lumbar area, situation which was ameliorated in the case of the experiment group, and the differences between the two groups present the following values:

- *for the forehand topspin from ball without effect*, the experiment group registers a plus of almost 10%;
- *forehand topspin from ball with effect (backspin type)*, the experiment group presents a progress of 9.64%;

2. By applying the standard questionnaire related to the subjects' anamnesis and life quality from both groups, highlighting the "health" issues in terms of 6 areas (pain, vitality, emotional reactions, sleep, social isolation, and physical mobility) as well as indicating the painful areas manifested during training or official games, the following conclusions have been drawn from this type of evaluation, thus hypothesis no. 2 being confirmed:

  - the efficiency of the amelioration protocol during the 2 tests for the experiment group was validated with the data gathered from Anamnesis, Personal history section, the lumbar region registering an amelioration of *78%*, the ankle joint *80%*, and at the level of the ankle joint a percentage of *100%*, the total amelioration level situating at approximately *52%*.

CHAPTER 18.
GENERAL CONCLUSIONS, ORIGINAL CONTRIBUTIONS AND PERSPECTIVES

18.1. General conclusions

The conducted scientific research has aimed to highlight the postural deficiencies and plantar imbalances present at juniors between the age of 10 and 12 years, who practice table tennis, involved in performance activity, through a methodology regarding their evaluation and amelioration, as well as identifying the influence of kinesiotherapeutic actions on the quality of topspin attack (number of successes, execution speed, and the procedure's biomechanics), all of these being done with the purpose of optimizing the performance capacity of the athletes.

The first part of this doctoral thesis was represented by the theoretical foundation, where the specialized literature was analyzed regarding postural deficiencies, plantar imbalances, morphological features specific to junior age and table tennis.

From the specialized articles related to our scientific interest, we have selected the most important information necessary to develop an evaluation and amelioration methodology for the postural plantar deficiencies, which will exert a beneficial influence upon the topspin attack quality.

I consider it opportune to detect these deficiencies in this age category with the purpose to improve the athletes' life quality because in this pubertal period there are accentuated changes both at the morphological level.

For the early detection of postural deficiencies in children, a modern device was used, named “Sensor Medica” doubled by software named “FreeStep”, useful in collecting and processing the data. This system was endorsed by the French Association of Posturology, useful information for our scientific endeavor for the evaluation within the pilot study from the second part of the paper, with real chances of being implemented in the experimental research.

The second part of the scientific paper represents the result of the study pilot in which we followed, by carrying out a social survey based on a questionnaire, the identification of the problems created by the topspin attack at the postural level in order to create a methodology for postural plantar evaluation and amelioration with possible qualitative influences of the topspin in junior III, in table tennis. At the same time, we have explored and chosen the working methods and tools represented by the baropodometry platform, audio-video camera, and the computer software FreeStep by Sensor Medica for the postural plantar evaluation, the biomechanical analysis software DartFish 30S, technical-tactical tests designed to highlight the quality of the topspin attack, anthropometric tests, and the recording mode to highlight the execution of the topspin

The third part is represented by the experimental research, where we have evaluated the body posture (frontal and sagittal plan), the foot plantar architecture (static and dynamic phase), somatic indices, the topspin attack, and the life quality. Then we have implemented a postural plantar protocol composed of action systems specific to the individualized orthotic insoles with influence upon the topspin attack, all of these being confirmed by the research results.

A progress factor is represented by the involvement of the trainers and athletes in this type of research, the postural and plantar balancing has an influence upon the quality of the topspin attack and implicitly upon the performance capacity. The approach to optimizing the life quality in order to improve the posture and a technical-tactical element using a methodology that consists of adequate means and methods specific to kinesiotherapy may have as a final result a superior position on the podium or in national and international rankings of juniors III.

The trainers’ rush for medals can represent, in some individual situations, a life philosophy with pathological implications that affect the life quality of the athlete. The evaluation at certain pre-established time periods regarding the body posture and the dynamic support mode are actions that should counterbalance the desire to climb as high as possible on the podium to the detriment of the athlete’s health.

18.2. Original contributions

The opportunity of studying the bibliographic material specific to the theoretical foundation of its own scientific approach has highlighted the lack of a previous national study regarding the postural deficiencies and plantar imbalances met in table tennis for this age category, as well as their influence upon the topspin attack in this sport.

We believe that this scientific research done through the applied methodology brought to light some original elements regarding the evaluation and postural and plantar amelioration, these being a starting point for further personal scientific research or for other specialists interested in this field represented by kinesiotherapy in performance sports.

Due to this, we could identify, analyze, and interpret certain data of interest of postural, plantar, technical-tactical, biomechanical, and life quality nature, the reason for which we decently believe that this scientific approach presents elements of originality useful for table tennis, but also for kinesiotherapy in performance sports.

By using the FreeStep program, the FreeMed (Sensor Medica) baropodometry platform, and the biomechanical analysis software in Romanian performance table tennis in junior III,

these favoured the objective identification of the support mode in dynamic of the juniors and the postural deficiencies, all of these constituting new elements which supported performant evaluation, but also the creation of the necessary means to ameliorate the identified deficiencies.

Another original element in our national table tennis is represented by the performant association of the individualized orthotic insoles and action systems which determine the amelioration of the two components at the level of the junior athletes, with a percent, *plantar* in the static phase of approximately *51%*, in the dynamic phase of *32%* and *postural*, in the frontal plan, a total of approximately *68%*, and in the sagittal plan of approximately ***7%***, a situation that we did not encounter during the study of the written profile materials.

The idea of studying in a theoretical plan with the purpose of developing and implementing a postural and plantar evaluation and amelioration methodology, which will influence the topspin attack in junior III, is an original element for this sport but also for the scientific research which we intend to continue in order to ameliorate the life quality of the athletes and to optimize their performance.

The means necessary to use the adapted methodology of non-invasive investigation useful for identifying the initial and final postural plantar deficiencies in this sport useful for monitoring the evolution of the detected disorders represent a national premiere. We think that these actions would be necessary to be introduced in a regular routine, especially at the level of children and junior, in order to ameliorate them early and, implicitly, to optimize their performance capacity. Therefore, these can be role models for kinesiotherapists who are part of the interdisciplinary team.

According to the age characteristics, this period of important morphological characteristics yields and it is opportune for the amelioration action at the postural plantar level upon the topspin attack, being an original element, this approach not being initiated.

In the end, I consider that an original element is the base concept of this thesis according to which a correct developed and implemented amelioration protocol will have a positive influence upon the technical-tactical quality of the topspin attack and on the shorter execution time, is finally validated by the obtained results and correlations within the experiment group.

18.3. Perspectives

The scientific research activity carried throughout the 3 years has developed my vision and gave me pleasure regarding the complementarity of the field of kinesiotherapy in table tennis. It stimulated me mentally in the sense of identifying other unexplored directions like discovering certain body devices and systems with a possible potential for influence in the technical-tactical sphere.

Therefore, the FreeMed baropodometry platform that I have used in the actual research constitutes support for evaluating the balance, the coordinative motor ability, which from my point of view can be a factor that influences the technical-tactical sphere and especially the attack. Moreover, in the twisting speed of the trunk, I take into consideration the fact that somatic development can bring changes to the technical-tactical level and I want to identify the differences between two age categories in this sport.

The present technological development gives me the opportunity to identify other means of evaluation specific to kinesiotherapy and to table tennis which if they are used according to a concept available to the scientific research, can represent a new source of information useful for

optimizing the performance capacity and to develop a theoretical and practical base for table tennis, but also for kinesiotherapy in performance sports.

The evaluation at the level of national junior, youth, and senior lots is a perspective that I am taking it into consideration, in order to identify the postural plantar status of the known athletes and implicitly the way their body has adapted on this direction as a result of intense practice during a considerable amount of time in this sport.

The identification of the influence of the prevention and amelioration actions specific to kinesiotherapy upon the junior athletes, in the sense of implementing them within the official leaderboard of the R.T.T.F. (competitional period), is another perspective that I am taking into consideration and to be approached by a scientific research team.

By completing the scientific research, the doctoral thesis will give me the possibility to develop and disseminate a wide number of specialized articles, which I want to publish in prestigious university journals and also to present them within international scientific conferences.

The evaluation of athletes from other motor fields is a viable perspective, in order to facilitate the awareness of the importance of kinesiotherapeutic evaluation and amelioration actions, the postural plantar health condition of athletes by the trainers and those responsible for performance activities.

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